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WORK OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION.

The International Electrotechnical Commission is now an organization having sub-organizations in nearly a score of different countries, comprising, in all, about three hundred specialists and using more than ten languages. The commission meets about every second year, but it is manifestly impossible for so diffused and heterogeneous a body to accomplish much new work at such a meeting. All that the official meetings can hope to effect is to accept or to reject formal resolutions submitted to its members in advance by correspondence. This requires that informal stated meetings should be held to draw up the resolutions for subsequent consideration by the main body. At the present time there are three sub-committees in definite existence, charged with the subjects of nomenclature, symbols and rating respectively. Ten countries are represented on these international sub-committees, and any or all countries are permitted to have delegates in attendance. The sub-committees will convene in Paris about the end of this month.

In regard to international electrical engineering nomenclature, the first step should be to complete a list of equivalent terms in the three important languages, English, French and German, so that when any important term—such for example as "rated load"—is employed in one of these languages its official equivalent in the other two languages may be immediately forthcoming. This is more especially necessary because English and French are the two official languages of the commission, and there should be no possible ambiguity as to the technical meaning of ordinary terms in those languages. Once nomenclature has been standardized in these languages, the work of extending the translations officially into the other languages may safely be intrusted to the local committees. In this matter of nomenclature the United States naturally looks to England as the joint representative, reserving the right to dissent from such provisionally accepted English terminology as American established differentiated usage may render necessary. As regards international symbols, an attempt should be made to reach agreement in sub-committee upon symbols for some one or more of the following electrical engineering quantities: capacity, power, work and electric potential, which are absent from the list of the ten quantities already symbolized internationally, namely, emf, resistance, current, quantity, self-inductance, magnetic force, magnetic flux-density, length, mass and time. The above fourteen quantities, if symbolized internationally, would make a very satisfactory list, and while it might ultimately be carried with advantage to twice that length, yet the need for such extension would be much less pressing.

As regards international rating, what is first wanted is a definite international set of rules by which the behavior

of a given direct-current machine may be accurately specified. In other words, once engineers can agree upon an international method of stating the facts concerning the behavior of a machine under test, with regard to autoregulation, heating, dielectric strength and the like, international agreement upon what performance should be expected from a machine will probably soon follow. A difficulty is likely to be encountered in formulating the international rules for observing temperature elevations. The first step might well be to agree upon a universally acceptable room temperature, or normal temperature of reference for the unloaded state. Advocates are found for taking normal room temperatures ranging all the way from 20 to 35 deg. C. This important step would have to be ratified by the commission as a whole and adopted in all of the local standardization rules. Another important step within the purview of the sub-committee to recommend would be the unification of copper-wire standards. A third might be an agreement as to the definition and mode of observing autoregulation in any direct-current machine—whether as to voltage, speed, current, etc. A fourth might be a recommendation as to dielectric strength called for in direct-current machines, as well as its mode of definition and determination. The main result that we may hope our international I. E. C. sub-committees will accomplish is the formulation of definite and clear propositions for the main body to receive in advance of the next official meeting in 1913, so that they may be carefully discussed, at length and at leisure, in the different national committees and national technical societies. In this manner the delegates coming to the next official meeting will know how to vote. If, on the other hand, the sub-committee fail to reach any definite proposals, the next official meeting is likely to be rendered ineffective.

THE ELECTRIC VEHICLE AND THE SMALL CENTRAL STATION.

The time has long since passed when the central-station industry was justified in maintaining a skeptical attitude toward the electric vehicle. Nothing is more significant of the splendid vitality of the electric-vehicle movement than the flood of business which the principal manufacturers are trying to handle during a year in which general industry is overcoming many obstacles, political and otherwise, and in the face of world-wide labor difficulties. The question before the central station is mainly one of policy, focused in the query "What is there in the electric vehicle for the small company, and how shall the benefits be realized?" At this late day it ought to be needless to emphasize the value of electric-vehicle battery charging during the hours of the night when the larger part of the plant is producing absolutely no revenue, and, more than this, when such portions of the equipment as are in operation are turning out electrical energy at a comparatively high unit cost on account of the poor load-factor which the installation has to carry between bedtime and sunrise. So far as the character of the load is concerned, the small central station is in a position to benefit just as much, relatively speaking, from the charging business as the big plant. In each case the returns are largely "velvet," for the service can be handled in practically every instance, if carefully planned, with only a trifling investment in distribution circuits and panels and without spending a single dollar for additional steam or electric generating plant.

Unfortunately, many small companies fail to realize the relatively small expense involved in performing this service, even as they overlook the point that almost any pleasure vehicle will consume at least $50 worth of electrical energy yearly, while a 2000-lb truck will easily purchase energy to the value of $300 if supplied at 5 cents per kw-hr. and operated steadily from day to day. Now, every manager of a progressive lighting or power company of small or moderate size knows that he lets no grass grow under his feet when a prospect of this order of consumption comes within range on an illuminating or motor-service proposition, and the time is fast approaching when an attitude of indifference to the electric-vehicle possibilities of his territory will no longer be accepted by his board of directors. It is a singular fact that the public is buying electric vehicles in large numbers even in towns where the local central stations are reporting the possession of no machines of their own, and in not a few cases where the lighting companies consider the conditions unfavorable to this type of transportation.

On general grounds, however, there can be no question that the purchase and use of at least one electric vehicle is an important initial step in any local campaign by the central station, and along with this go the keeping of a few simple but supremely necessary records as to mileage, energy consumption, service and cost of operation which give the central-station man something tangible to point to from his own experience, even when dealing with prospective customers whose conditions are quite different. The most progressive central stations are planning to eliminate all their horse-drawn equipment, and it is safe to say that such a step does more to stimulate the use of electric vehicles in a community than any other argument which the company can summon. In the work of delivering lamps, setting poles, handling line construction, carrying men to and from jobs remote from the plant, installing meters, inspecting and maintaining street-lighting equipment, reading meters located at scattered points, thawing out frozen pipes and repairing damages to the overhead or underground system the electric vehicle stands ready to perform difficult tasks with flexibility, reliability and economy.

Outside the company's system the electric vehicle's opportunities, even in a small city or town, are considerable. In the delivery of wholesale provisions, distribution of coke, shipment of textiles and lumber and delivery of coal in these centers there exists an almost virgin field. Modern types of electric runabouts are capable of meeting the demands of the country doctor, his radius of action seldom exceeding 15 or 20 per cent of the mileage possible per charge, and the well-to-do residents of small cities and towns are natural customers for electric pleasure vehicles within their extending field of usefulness. The cost of exploiting the electric vehicle need not be "viewed with alarm." The celebrated Boston campaign represents to date an expenditure of not much over 10 cents per capita. As indicated, the energy consumption of fifteen electric trucks of 2000-lb. capacity amounts yearly to $4,500, representing a gross profit of 30 per cent upon the investment

of $15,000 in a campaign by any company serving a city of 150,000 people. In still smaller places a very moderate per capita expenditure, say 20 or 25 cents, will go far toward putting the lighting company's own transportation department upon a basis of more efficient operation and toward arousing public interest in the electric vehicle as an economical mechanism. Skilled supervision of vehicles placed in service is fundamental to the lasting success of the industry, however, and arrangements for this must be made between the central station, the manufacturer and the purchaser as a basis of further advance. As small central stations take up the work, opportunities will arise for co-operative inspection and maintenance which will insure satisfaction to users unfamiliar even with the simple mechanism of the electric vehicle and become potent factors in securing the repeat orders which are the crowning triumph of the present-day industry.

A STUDY OF MOTOR TRUCKS.

A report elsewhere in our columns on the tests of motor vehicles now being conducted at the Massachusetts Institute of Technology is of great and timely interest as showing both the need of investigation and the classes of facts which careful study may bring out. The one most conspicuous thing which stood out at the very beginning of the investigation of the subject was the absolute and dismal ignorance prevailing among the users of motor trucks of every kind regarding all the economic factors which had to do with their use. It has, therefore, come to pass that the most important function of the technical investigators has been to find out what the users of the vehicles do not know, and the manufacturers do not tell even if they know, which is doubtful. There is at the present time a large element of fashion and of advertising in the use of motor vehicles, the real importance of which it is hard to estimate. Among tradesmen the operation of a motor delivery service is quite apart from any inherent economy which may be secured. If Jones, Smith & Company establish motor delivery wagons for their grocery business, Brown, Robinson & Company must immediately do the same under pain of being considered behind the times.

Whatever the economical results of the delivery by motor may be so far as costs per package are concerned, the merchant generally does not know, and probably does not care, since in these days of rising prices it is a perfectly simple matter to charge up the extra costs, if any, to the consumer or to charge them up anyhow and take the profit. This particular class of service, therefore, the ordinary delivery work, is perhaps the least amenable to a proper economic study. The business of large trucking concerns doing heavy work affords a much better chance of getting definite data, and this class of service is one that is particularly under investigation in the research here considered. Here the advertising feature of the game has little or no weight, since the profits are those obtained by actually handling a large volume of goods. In other words, in the heavy trucking business, whether urban or suburban, the motor operation gets strictly down to its merits, while in the light mercantile delivery business any incidental losses or gains are quite swamped in the profit which comes out of the purchaser in any case. The study of the subject is, of course, as yet very incomplete, but enough has been ascertained to bring to the front some facts of material interest.

The first thing of striking importance which appears is the definite and immediate bearing of the load curve, so to speak, of transportation upon the economy of using motor vehicles. The cost of the vehicles themselves is well known to be high and the cost of upkeep considerable—just how great, few manufacturers would care to have published; but, on the other hand, despite these costs, if a motor truck can make, as it unquestionably can, two or three times the mileage per day of an ordinary truck of similar hauling capacity, the extra cost of maintenance and investment drops out of sight in the increase of 200 or 300 per cent in the profits per day. Where one big electric truck, for example, can replace two teams of similar hauling capacity by being able to make mileage equal to both the competitors together, one need not worry very much about the cost of energy for batteries and the probable depreciation of the solid tires. On the other hand, the two teams can be in two places at once, and unless the motor can be kept loaded with profitable freight, its daily earnings may not be great enough to justify its expense. The present investigation indicates that both these conditions are found in practice—the truck profitable by reason of its greater mileage, and unprofitable on account of too long periods of standing idle. The broad scope of the investigation is well shown by the fact that, although primarily instigated and backed by the Boston Edison Company, it covers every type of motor vehicle and will set forth the exact facts regardless of the position of the electric vehicle in the competition.

There is little reason to doubt, we think, that in city work the electric vehicle can hold its own, and this is particularly true in the case of the light delivery wagon to which reference has already been made. The advertising value of a smartly appointed motor car, delivering, let us say, for a florist, a modiste or a haberdasher, is not a thing to be lightly set aside. There is no doubt of the psychological effect on the person next door when such a vehicle draws swiftly up to an elegant residence and discharges its bundles, as compared with the clattering irruption of an ancient horse-drawn cart with a shabby attendant. In this class of service it is quite safe to say that the electric vehicle would be justified at double the cost of the older methods. It is akin to the common method of estimating the social importance of a person by the size and equipment of his garage. In the heavier trucking service the contest as between electric and other motor vehicles is on more even terms. For the very long cross-country hauls necessary for some expressmen, furniture movers, and the like, the greater continuous mileage of a gasoline-driven machine counts, just as it counts in long-distance touring with ordinary motor cars. In strictly city and suburban work the case is different, and it is to be hoped that the study now in hand will bring out the important facts of the case. It is certainly an admirable example of practical business foresight applied to research and cannot fail to have an excellent result on the industry. If it shows the limitations of motor trucking, it will also show the perhaps unexpected conditions under which it appears to great advantage.

PATENT LEGISLATION BY CONGRESS.

According to present indications, there is little likelihood of any new patent legislation being enacted at this session of Congress. Those opposed to patent reform as a menace to their interests appear to have full control of the situation, while inventors appear to have no channel through which to bring to bear any influence.

In the first place, so far as the House is concerned, Speaker Clark is at this time opposed to any extension of patent legislation; and in the second place, so far as the Senate is concerned, members of the upper chamber, particularly the lawyers in the body, believe that, in view of the recent Supreme Court decision in the Henry et al.-Dick case any new patent bill which is to have the approval of the Senate should be drawn by the Attorney-General. Up to Wednesday evening, however, the Senate committee on patents had not made a request of the Attorney-General.

Furthermore, it would take the Attorney-General's office some time to prepare such a bill, and it is unlikely that his office would undertake to do so until it first had at hand the benefit of hearings before the Senate patent committee.

There are now before the Senate committee on patents seven bills relating to various proposed amendments to the patent laws and one concurrent resolution, the latter being the proposition submitted by Senator Gore to provide for a joint committee of both houses of Congress "to investigate the methods of selling, leasing and controlling patented articles or inventions." Mr. Gore also has before the Senate committee a bill "to provide for compulsory license for the manufacturing of patented articles," which includes one or two other items amending the present patent laws.

Both of Mr. Gore's propositions have been before the Senate since May 8, 1911, and he is understood to be preparing another bill which shall take cognizance of the so-called defects in the present patent laws which were pointed out in the minority opinion submitted by Mr. Chief Justice White in the Supreme Court decision in the Dick case. He has, however, made no definite progress in the framing of this new bill at this time.

Senator Kenyon, who has been reported to be another framer of a proposed new patent law, has not yet undertaken the work, and he is not likely to do so for some time.

Senator Brown, however, the chairman of the Senate patent committee, is now hard at work on a bill which he intends at least to introduce at this session, according to his own statement, which he does not think it will be necessary to submit to the Attorney-General's office. Senator Brown, who is noted for tenacity of purpose, desires at this time to maintain silence as to the provisions of his proposed bill, contenting himself with the statement that he will do his best to obtain some action on the measure. That it will meet with success in the Senate at this session is doubted, in view of the definite statement of one of the jurists of the Senate, of whom there are quite a number, that any proposed new patent law ought to have the sanction of the Attorney-General's office. In general, it may be said that Senator Brown's proposed measure will attempt to alter the patent law along lines of thought suggested by the minority opinion of Mr. Chief Justice White in the Dick case.

This, in fact, seems to be the object of a number of members of Congress who have studied the present patent laws and who are not swayed, as some members are, by the well-developed opinion that the leaders in both houses will regard attempted patent legislation at this session as being in the nature of dangerous politics.

Thus, in the attempt to obtain legislation deemed advisable in view of Mr. Justice White's opinion, Representative Oldfield, chairman of the House committee on patents, expects to receive from Commissioner of Patents Moore a bill which the latter has drawn along such lines. Up to Wednesday it had not been decided whether or not this bill would be introduced at this session. Mr. Moore states that he prepared the bill six weeks before the Dick decision, without knowledge, of course, of what that decision would be, and he was of the opinion on Wednesday that his bill contains everything that manufacturers, patentees or jurists could desire. The exact language of the bill, he—sharing Senator Brown's position—desires to keep to himself until it is introduced, contenting himself with the statement that it may not be introduced at this session, but if introduced, it will be within ten days.

The Commissioner of Patents, who has spent some twenty odd years in his present work, believes that it might be jeopardizing the chances of the bill to attempt to introduce it at this session, when so little time remains for the passage of even the necessary appropriation bills, it being well understood that Congress will adjourn early for the campaign. He was asked by Representative Oldfield to prepare the bill, and had been assured by the latter that the measure stood a good chance of going through the House, at least, at this session; but the remark of Speaker Clark, who is himself thoroughly familiar with patent legislation, having served on the committee, that he "thought it had been settled that there would be no extension of the patent legislation, and that there was too much of it," attracted Mr. Moore's attention, and it is likely that Mr. Clark, while not outlining a definite policy for the remainder of the session, in making this statement was expressing the view of the leaders. Representative Oldfield believes that under the present law patentees have too much power to say what appliances shall or shall not be used on the machines they patent, and his committee asked Commissioner Moore to draft a law which would alter that situation.

There are no less than twenty-one bills before the House committee on patents, many of them, however, merely measures for the internal regulation of this or that branch of the Patent Bureau; and it is considered quite likely that if a number of these are acted upon by the committee they will consume much of the time remaining before the adjournment of Congress without the committee itself being taxed with hearings and debates on a comprehensive alteration of the law, such as would likely be necessary before Commissioner Moore's bill could be favorably reported and placed in a strategic position for its passage by the House, to say nothing of the desire in the Senate that such a law shall be approved by the Attorney-General.

PROPOSED REHEARING OF SUPREME COURT DICK PATENT CASE.

Attorney-General Wickersham has made application to the Supreme Court on the part of the United States government for leave to intervene and for a rehearing of the Dick patent case, which recently was the subject of a decision by that court of far-reaching effect on inventors and manufacturers in general. In support of its application, the government states that the Dick case is not limited in its significance and consequences to the parties of record, but is of the gravest import to the people of the United States and concerns the government in a number of cases, civil and criminal, now pending, for the enforcement of the anti-trust laws.

The decision, it is stated, involves the construction of Paragraph 8 of Section 8 of Article I of the Constitution of the United States, which provides that the Congress shall have power "to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries," in that it calls for a determination of the nature and extent of "the exclusive right" which may thus be secured. It involves the construction of the statutes of the United States which have been enacted pursuant to the above-recited provisions of the Constitution, in that it calls for a determination of the nature and extent of "the ex-

clusive right" which authors and inventors have secured under those statutes to their respective writings and discoveries. It involves the construction of Paragraph 3 of Section 8 of Article I of the Constitution, which provides that the Congress shall have power "to regulate commerce . . . among the several states," in that it calls for a determination of the question of how far the exclusive right of authors and inventors to their respective writings and discoveries limits this power of Congress to regulate commerce among the several states. It involves the construction of the act of Congress known as the Sherman anti-trust act and the amendments thereto, enacted in pursuance of the last-mentioned provision of the Constitution, in that it calls for a determination of the question whether things done otherwise in violation of said act may lawfully be done as an exercise of the exclusive right of authors and inventors to their respective writings and discoveries.

Referring to the details of the Dick case, it is stated that the two letters patent involved, "covering a stencil-duplicating machine known as the rotary mimeograph," do not, either of them or together, cover a stencil-duplicating machine broadly, but only minor improvements upon such a machine. They do not, either of them, cover or relate to stencil paper, ink or other supplies required for stencil duplication when the machine is used for that purpose, nor do the patents, or either of them, cover the process of stencil duplication.

The license restriction is quoted and also a circular sent "to the trade and users of mimeographs," which, after warning against infringements of certain letters patent other than those involved in this suit, proceeds: "Quite apart from these patents, attention is called to the fact that the mimeograph is sold under a proper license restriction precluding the use therewith of stencil paper, ink and other supplies not of our production. The sole legal right to make and sell such supplies for use on said machine is vested in us, and this right has been repeatedly upheld by the courts in suits heretofore brought to enjoin the sale of spurious supplies for that use."

It is contended by complainant that by this "license restriction" it succeeds in vesting itself with "the sole legal right to make and sell such supplies for use on said machine," and that this right which it has thus secured for itself is not a right growing out of the contract, express or implied, entered into by the purchaser of the machine, but is a part of that exclusive right authorized by the Constitution and conferred by the patent laws upon inventors to their respective discoveries; and, in case of impairment, the grievance may be redressed, not simply by suit for breach of contract, but by suit for infringement of the exclusive right secured by the letters patent.

The application states that the so-called "license restriction" is simply imposed by the A. B. Dick Company, and no agreement embodying it is entered into by anybody, save as such an agreement by a purchaser of the machine may be implied from the mere fact of purchase.

"The surviving appellant, Margaret Henry, is not a purchaser of one of the machines, nor the user of one, but is a dealer, among other things, in 'stencil paper, ink and other supplies,' appropriate to be used in the process of stencil duplication by stencil-duplicating machines. She is held to have had notice of the 'license restriction,' and as none the less she sold 'stencil paper, ink and other supplies' to a user of a mimeograph made by complainant, with the expectation that it would be used in the process of stencil duplication by that machine, she was sued as a contributing infringer, not of any patent relating to any of such supplies or to the process of stencil duplication, but of patents relating exclusively to the machine.

"The result of the decision against her is that the right to make, use and vend 'stencil paper, ink and other supplies,' which are in themselves free of any patent monopoly, to the extent of the use of such supplies in connection with the process of stencil duplication by mimeographs made by complainant, is by the mere assertion of the complainant made subject to the exclusive right of the complainant under its letters patent relating to minor improvements of the mimeograph.

"If the 'license restriction' imposed in this case is within 'the exclusive right' authorized by the Constitution and conferred by the patent laws, then any condition whatsoever imposed by a patentee upon the use of his invention is within that right. The Circuit Court so held in terms, saying that the patentee might limit or restrict the use of his invention 'in any way he sees fit, however ridiculous such restriction may seem.' If the restriction may be ridiculous, or, as the Circuit Court also says, 'whimsical,' it may also be oppressive and unjust, and, if applied to any other form of property, illegal, for, as construed in this case, the exclusive right means an absolute right which acknowledges no limitations."

The application asserts that the decision extends the power of property held under letters patent beyond the warrant of the Constitution and the grant of the patent laws, and puts it above the authority of Congress to regulate commerce among the several states, and above the universal limitation expressed in the maxim "So use your own as not to injure another's."

"Precedents for the decision may be found in a number of cases in the circuit courts and in the circuit courts of appeal, but none, it is believed, can be found in any case decided by this court, while, on the other hand, the decision is, in our judgment, in direct conflict with those of Bobbs-Merrill Co. v. Straus, and Miles Medical Company v. Park & Sons Company.

"As we understand the Constitution and laws of the United States, the extent of the right of property is the same, whatever the species, and in no case is absolute. The exclusive right given by the copyright and patent laws to authors and inventors in their respective writings and discoveries has reference to the peculiar nature of that property, which, as it is a thought or idea and as soon as expressed is susceptible of appropriation by anybody and everybody, needs a peculiar means of protection. When the author publishes a book he needs protection not simply against the appropriation of that book, but as well against the reproduction by someone else of its contents in another book. When the inventor expresses his invention in a machine he needs protection not only in the possession and use of that machine, but as well against the expression by someone else of the invention in another machine. In other words, the property of the author secured by the copyright is in the literary contents of his book, and not simply in the material thing, the book, in which he embodies them. And so it is as to the property of the inventor in his discovery.

"Material property, as it may be held in physical possession, does not require the peculiar means of protection accorded to writings and discoveries, but a man has as much a monopoly of the horse or the wagon he owns under general laws as he has of a writing or invention under copyright or patent laws. He may annex ridiculous or whimsical conditions to the sale of his horse, but his right to enforce those conditions, if legal, grows out of and depends upon the law of contract. And so it is as to the invention; he may make contracts with respect to it as he would with respect to any other species of property, and these contracts may be enforcible as such, but he cannot by mere contract bring anything within the exclusive right conferred by the patent laws. That can only be done by invention.

"The importance of the question here involved cannot be overestimated. The number of letters patent issued by the United States during the last seventeen years is 484,780. And this is the number now in force. True they are expiring every day. But seventeen years ago the average daily issue was fifty-seven, while now it is ninety, so that the number of existing letters patent is constantly increas-

ing. Letters patent issue for the invention or discovery of any new and useful art, machine, manufacture or composition of matter, or any new or useful improvements thereof. Existing letters patent are comprehensive of the whole field of material endeavor, extending to every branch of every art, industry and business; and the entire production and commerce of the country may be greatly burdened, and even completely monopolized, if the exclusive right of inventors may be extended beyond their inventions, and be made to embrace any and every thing—material, machine, process or product—in connection with which such inventions may in some way be employed.

"It has come to pass in some branches of manufacture and commerce that a monopoly is attempted by means of extending the dominion of letters patent over things not within the scope of the invention secured by them. A patent for a process or for an improvement upon one is stretched to secure 'the sole legal right' to supply the raw material employed in the process or to control the disposition of the resulting product. In an industry in which a number of machines different in kind are required to make the staple of the factory, a patent for one of the machines, or for an improvement upon one of them, is made the means of securing the monopoly of supplying all the machines of all the kinds used in the factory. That is not the monopoly awarded to inventive ingenuity by the patent laws, but is a monopoly devised and secured by commercial cunning in violation of the anti-trust laws.

"We respectfully submit that the restrictions, ridiculous or reasonable, which may be imposed in virtue of the patent laws and the disregard of which may be dealt with as an infringement of the exclusive right conferred by those laws are such as are related entirely to the use of the invention itself. When the patentee goes beyond this and yokes his invention with something else, he acts only in virtue of his right of contract as an owner of any other property may do, and not otherwise, subject to all the limitations upon that right imposed by any law of the land. He may by contract divest himself of his monopoly, in whole or in part, as by assignment of the patent or the sale of a patented machine, but he cannot by contract or by mere assertion bring something else not patented within the monopoly. The distinctive right conferred by the letters patent cannot be made by the act of the patentee to attach to anything in which some quality of his invention does not exist. It springs from the invention and is limited to the invention, and while it is exclusive, it is not absolute; and so a contract, although it is related to the invention, if its purpose and effect is to secure control or monopoly of something else than the invention, is not saved, even as a contract, by anything in the patent laws, but offends the public policy of the United States and is void as being in restraint of trade.

"The present case was not considered by the full bench, and the decision herein was made by less than a majority of the court. It has been the general, if not the uniform, usage of the court in cases such as we conceive this to be to have a determination of them whenever possible by a full bench; and to secure this they have been postponed for hearing, or after argument and submission, and even after decision, when the decision has been by less than a majority, they have been restored to the docket for reargument."

In support of the above argument, opinions are quoted, among others the following by Chief Justice Marshall:

"The practice of this court is not (except in cases of absolute necessity) to deliver any judgment in cases where constitutional questions are involved unless four judges concur in opinion, thus making the decision that of a majority of the whole court."

The application concludes with a prayer that the case be restored to the docket for reargument, and that the United States be heard upon the reargument in behalf of the public interests which are involved.

I. E. C. REPORT OF TURIN MEETING.

The International Electrotechnical Commission has issued a report of the Turin meeting of that body, copies of which may be obtained from the central office, 28 Victoria Street, Westminster, London, England, for 1 cent, post free.

In opening, the report gives a short synopsis of the contents. The decision in regard to future electrotechnical congresses, which appears on pages 86 and 88, has now been ratified by all the local committees.

Through the initiative of the American committee, the United States Treasury Department has given instructions that in future the reports of the I. E. C. are to enter New York free of duty. In view of the heavy duty on literature entering the United States, this action of the government is a signal recognition of the value of the work of this international movement.

Mention has previously been made in regard to the meetings of the special committees on nomenclature and symbols, which are to be held in Paris this month. At the request, however, of the American committee, the meeting of the special committee on the rating of electrical machinery has been postponed until April 29.

The American committee will be represented on the special committee on rating by Mr. C. O. Mailloux (president of the United States committee) and Prof. C. A. Adams, of Harvard University. The Italian committee will be represented by Prof. E. Morelli, accompanied by Signor Semenza; Sweden by Mr. J. L. la Cour, and Germany by Herr Leo Schuler, the general secretary of the Elektrotechnischer Verein. The names of the other delegates have already been announced.

A. I. E. E. MEETINGS.

In addition to the meeting of the American Institute of Electrical Engineers in New York on April 5, when Mr. Samuel Insull presented a paper on "The Relation of Central Station Generation to Railway Electrification," other meetings have been arranged to take place during the present month at Portland, Ore., and at Pittsburgh, Pa.

The Portland meeting will be held from April 16 to April 20. Among the papers to be presented will be the following: *Operation of Two Alternating-Current Stations Through Parallel Circuits and the Distribution of Load and Wattless Current Between Them,* by Mr. J. W. Welsh; *Air-Gap Flux Distribution in Direct-Current Machines,* by Mr. Charles R. Moore; *Principles to Be Considered in Selecting a Waterwheel Unit,* by Mr. O. B. Coldwell; *Irrigation in the Spokane Valley,* by Mr. L. J. Corbett; *An Underground System and a Few Developments,* by Mr. S. B. Clark; *Alternating-Current Systems of Underground Distribution,* by Mr. S. J. Lisberger and C. J. Wilson; *Automatic Private Branch Exchange Development in San Francisco,* by Mr. Gerald Deakin; *Application of Automatic Selecting Devices to Telephone Multiple Switchboards,* by Mr. Alfred H. Dyson; *Plant Efficiency,* by Mr. J. D. Ross; *Practical Joint Pole Construction,* by Mr. J. E. Macdonald; *Design of Telephone Pole Lines for Conditions West of the Rocky Mountains,* by Mr. A. H. Griswold; *Arc Versus Tungsten Street Lighting in Small Towns,* by Mr. C. E. Stephens; *Mechanical Results of the Use of Suspension Insulators,* by Mr. V. H. Greissner, and *Long-Distance Telephone Transmission on the Pacific Coast,* by Mr. C. A. Turner.

Headquarters of the Institute will be at the Hotel Multnomah, where the sessions will be held. Transportation at one and one-third first-class single fare will be obtained over certain roads during the three days prior to the opening of the meeting, on the certificate plan.

From April 25 to 27 a combined meeting will be held by the Pittsburgh Section of the Institute and the Association of Iron and Steel Electrical Engineers. The papers to be presented include the following: *The Electrical Construction of a Large Mine Hoist,* by Mr. H. W. Cheney; *The Use of Alternating Current in Unloading Coal,* by Messrs. W. N. Ryerson and J. B. Crane; *Electrification of a Reversing Mill of the Algoma Steel Company,* by Mr. Bradley T. McCormick; *Self-Starting Synchronous Motors,* by Mr. C. J. Fechheimer; *Does It Pay the Average Coal Mine to Purchase Central Station Power?* by Mr. G. Bright; *Direct-Current and Alternating-Current Mill Motors for Auxiliary Drives,* by Mr. Brent Wiley; *Advantages of Automatic Control in Steel Mill Operation,* by Mr. Stewart C. Coey; *Operation of a Large Electrically Driven Reversing Mill,* by Mr. W. Sykes; *The Electrical Braking of Induction Motors,* by Mr. C. H. Specht; *Motor-Driven Reversing Mill at American Sheet & Tin Plate Company,* by Mr. J. E. Smith, and *Application of Motors to Large Valves and the Method of Controlling Them,* by Mr. H. M. Gassman.

The Fort Pitt Hotel will be the headquarters of the Institute during the meeting. Trips will be made to various industrial plants in and around Pittsburgh.

During next month on May 17 a meeting will be held at Schenectady under the auspices of the Schenectady Section of the A. I. E. E. The following papers will be presented for discussion: *The Induction Generator,* by Mr. H. M. Hobart; *Electrical Characteristics of Suspension Insulators,* by Mr. F. W. Peek, Jr.; *Propagation of Impulses on a Transmission Line,* by Messrs. J. H. Cunningham and C. M. Davis; *Ozone; Its Properties and Its Commercial Production,* by Dr. M. W. Franklin; *Protection Against Surges on Electric Railways,* by Messrs. E. E. F. Creighton, F. R. Shavor and R. P. Clark; *Lightning Protection for 2300-Volt Pole Transformers,* by Messrs. E. E. F. Creighton and F. R. Shavor; *Multi-Discharge Recorder for Recording Switching and Lightning,* by Messrs. E. E. F. Creighton, H. E. Nichols and P. E. Hosegood; *Modern Construction of Transmission Lines,* by Mr. R. A. Worcester; *Some Impressions of the Electric-Traction Situation in Europe,* by Mr. C. E. Eveleth; *Notes on the Actual Cost of Electrification,* by Mr. J. R. Hewett; *Gas-Electric Cars,* by Mr. E. E. Kimball; *Freight Train Tests on an Electric Interurban Railway,* by Mr. S. T. Dodd; *The Generator in Transmission Work,* by Mr. D. B. Rushmore, and *Instantaneous Variation of Candle-Power of Lamps as Effected by Dynamo Regulations,* by Mr. H. F. T. Erben.

Among other entertainment features which will be provided by the local section will be several demonstrations of high-tension line phenomena.

A special feature of the annual convention of the Institute, to be held in Boston from June 24 to 28, will be a session devoted to electrical measurements at which will be read a large number of very short papers dealing with some specific points in electrical testing.

MEETINGS OF THE NEW YORK ELECTRICAL SOCIETY.

The New York Electrical Society has arranged an especially attractive program for the closing month of the present season. Among the speakers will be Dr. C. P. Steinmetz, Prof. Michael I. Pupin and Mr. William Marconi. The address of Mr. Marconi, on the subject of "Wireless Developments," will be delivered in the auditorium of the Engineering Societies Building on April 17, and it will no doubt attract one of the largest audiences that spacious hall has ever held, as the occasion will be the first on which Mr. Marconi has appeared in this country before an engineering and scientific audience, excepting the memorable dinner given to him by the American Institute of Electrical Engineers in January, 1902, to celebrate the transmission of the signal letter "S" across the Atlantic.

The present season has been one of the most active and prosperous enjoyed by the society in many years. This has been due doubtless in a large measure to the excellent program provided for the meetings, which has included papers on "Electric Waves Directed by Wires for Intercommunication Purposes," by Major George O. Squier; "Electrical Investments for Electrical Workers," by Mr. Henry L. Doherty; "A Scientific Hunting Expedition, with Special Reference to the Tsetse Fly and the Sleeping Sickness," by Dr. Louis Livingston Seaman, and "Electricity as a Factor in Progressive Agriculture," by Mr. E. P. Edwards—which has been published in the society *Transactions;* a visit to the Carnegie Hall telharmonium installation with an address on "Electric Music: Its Present and Future," by Dr. Thaddeus Cahill, and "The Uses of Electricity in Medicine and Surgery, in Accordance with Modern Standards," by Dr. William Benham Snow.

PRESENTATION OF A. I. E. E. HONORARY MEMBERSHIP CERTIFICATE TO C. E. L. BROWN.

The distinguished Swiss electrical engineer, Mr. C. E. L. Brown, arrived in this country recently on his way home from a trip around the world, and his arrival in New York was made the occasion of a presentation to him of an engrossed certificate of honorary membership in the American Institute of Electrical Engineers, which distinction was conferred at a meeting of the board of directors on Jan. 12.

A dinner was arranged for the evening of Thursday, April 4, when it was discovered at the last moment that Mr. Brown would have to sail on the morning of Tuesday, April 2. A large number of acceptances had already been received for the dinner on Thursday evening, and the change in date prevented a great many of the officers from being present who had planned to do so. Under the chairmanship of President Dunn, a party of ten sat down on Monday evening in the Tapestry Room at the Engineers' Club, when the resolutions adopted by the Institute recognizing the work of Mr. Brown were presented to him, beautifully engrossed on parchment, signed by President Dunn and Secretary Hutchinson, bearing the seal of the Institute and appropriately framed.

The dinner was a successful affair, and all present, including the guest of the evening, had something to say. Brief speeches in recognition and commendation of Mr. Brown's contributions to science and engineering were made by President Dunn, Past-presidents Martin, Lieb and Stott, Mr. C. A. Mailloux, Messrs. Rugg, Scribner and Barnes, members of the Council, and by Mr. Brown's prospective son-in-law, Dr. Meyer Delius. Letters and telegrams of regret were received from Messrs. Sprague, Scott, Steinmetz, Duncan, Weaver, Stanley, Hering, D. C. Jackson and Morgan Brooks. It is twenty years since Dr. Brown previously visited this country, but he hopes to raise his frequency and to return for the San Francisco Exposition and the International Congress of 1915.

Following is the text of the resolution conferring honorary membership on Mr. Brown:

"Whereas C. E. L. Brown has rendered eminent services to electrical engineering as a pioneer in the electric transmission of power, in the creation of types of electric generators and motors, and in the design of electrical apparatus; and

"Whereas the constitution of the American Institute of Electrical Engineers provides that by the unanimous vote of all the members of the Board of Directors honorary members may be chosen from among those who have rendered acknowledged eminent services to electrical engineering or its allied sciences; it is

"*Resolved,* That Charles Eugene Lancelot Brown, of Baden, Switzerland, be elected, in recognition of his numerous contributions to electrical engineering and its arts, to honorary membership in the American Institute of Electrical Engineers."

A very complete account of the career of Mr. Brown is given in an article by Mr. B. A. Behrend, entitled "The Debt of Electrical Engineering to C. E. L. Brown," which extended through eight issues of the *Electrical World,* beginning Nov. 16, 1901.

THE ELECTRIC VEHICLE AT BOSTON.

At a regular weekly meeting of the Luncheon Club branch of the New England Section of the N. E. L. A. on March 15 a paper was read by Mr. W. P. Kennedy, consulting engineer, New York City, on "The Adaptability of Electric Vehicles." The author pointed out that about 5000 commercial and 15,000 pleasure vehicles of the electric type are now in service, representing an investment of about $40,000,000. It is estimated that by Sept. 1, 1912, there will be $60,000,000 worth of this type of apparatus in use, representing a total annual energy consumption of 65,000,000 kw-hr. For the past two years nearly 70 per cent of the commercial vehicles put into service were purchased on repeat orders. There is great need of wider publicity regarding the simplicity of the electric vehicle, in order that the business may grow still faster. Insufficient data exist as to the cost of horse service in many instances. More attention needs to be given to the economics of loading and unloading. The author concluded with the accompanying tables of comparative cost data, secured at an expense of about $30,000. Two classes of service are covered in the tabulation. One represents the haulage of heavy loads requiring vehicles of 2 tons and 5 tons capacity, and the other group represents medium service, the vehicles being mainly 1-ton and ½-ton machines. The principal feature is the value of saving to be made and its proportionate relation to the existing cost and to the investment necessary to bring about the reduction. It is also interesting to note the proportionate relations between present horse investment and machine investment, as well as the ratio of machine expense to horse expense. The figures relating to horse equipment are certified as correct by the owners of the installations, and the machine equipment has been determined in every case after a complete demonstration and analysis of the working conditions. These demonstrated results have been agreed to as convincing and satisfactory by the interested executives in every case, and the data are therefore of unusual value.

TABLE I.—COMPARATIVE COST DATA FOR ELECTRIC AND HORSE-DRAWN VEHICLES, HEAVY SERVICE.

No. of Horses	No. of Machines	Investment. Horse	Investment. Machine	Total Fixed and Operating Expenses. Horse	Total Fixed and Operating Expenses. Machine	Annual Saving	Earnings in Percentage of the Investment	Saving Over Horse Expense, per Cent.
75	44	94,551	166,733	136,746	113,087	23,660	14.2	17.5
30	11	26,615	36,584	44,198	28,378	15,819	43.2	35.7
16	5	7,975	17,784	15,587	11,557	4,0300	22.6	25.8
121	60	129,141	221,101	196,531	153,022	43,509	19.6	22.0
Relative proportions:		1:0.5	1:1.70		1:0.77			

TABLE II.—COMPARATIVE COST DATA FOR ELECTRIC AND HORSE-DRAWN VEHICLES, MEDIUM SERVICE.

No. of Horses	No. of Machines.	Investment. Horse.	Investment. Machine.	Total Fixed and Operating Expenses. Horse.	Total Fixed and Operating Expenses. Machine.	Annual Saving	Earnings in Percentage of the Investment.	Saving Over Horse Expense, per Cent.
35	31	36,485	83,003	91,530	70,663	20,867	25.6	23.0
17	10	14,300	23,500	29,074	18,972	10,102	42.9	34.0
33	20	21,848	51,126	50,249	38,444	11,805	23.0	23.3
21	14	39,778	46,170	41,593	31,802	9,791	21.2	23.5
48	37	54,095	75,598	115,284	75,745	39,539	52.3	34.2
151	112	166,506	279,397	327,730	235,626	92,104	32.9	28.0
Relative proportions:		1:0.72	1:1.67		1:0.72			

Active steps are to be taken at once to broaden the scope of the Electric Vehicle Club of Boston, according to an announcement made at the regular weekly meeting and luncheon on April 3. Through the courtesy of the Boston Edison company, central-station men outside its territory will be successively invited to attend meetings and contribute to the discussion of electric-vehicle topics. Efforts will be continued to acquaint electric vehicle and accessory manufacturers with the campaign the club is making and plans are under consideration for the preparation of a regular bulletin of current progress. At the latest meeting it was stated that the president of the club will shortly give an illustrated lecture on electric fire apparatus before the Brookline (Mass.) department.

During the meeting it was stated by General Superintendent W. H. Atkins of the Boston Edison company that plans are afoot in England for the organization of a special tour to America in the coming fall in connection with the Boston 1912 Electric Show. Messrs. Cook & Son are arranging to conduct a party of not less than eight persons to the United States, leaving Liverpool on the *Campania* Sept. 14 and returning by Oct. 11 on the *Titanic* via Southampton. The itinerary includes visits to the points of electrical interest at New York, Philadelphia or Schenectady, Niagara, Toronto, the St. Lawrence River, Montreal and Boston for £85 first class, or £62 first class on steamers only. Space in the Electric Show has been sold to electrical interests in Manchester, England, and it is expected that the exhibition at Boston will prove of great interest to many foreign engineers and central-station men.

UNDERGROUND-CONDUIT CONSTRUCTION DISCUSSED AT BOSTON.

At the regular weekly meeting of the Luncheon Club branch of the New England Section of the N. E. L. A. on March 29, at Boston, an illustrated talk on "Underground Conduit Construction" was given by Mr. D. A. Harrington, Boston, a consulting engineer well known in the central-station field. Mr. Harrington described the principal systems in use in modern practice, emphasizing the growing demands now in evidence for watertight construction. Quality of ducts used is of great importance. The cost of ducts is usually only 10 or 15 per cent of the cost of the finished conduit, so that an increase or decrease of even 50 per cent in the duct cost means only a change of 5 per cent in the total cost of the conduit. Undue prominence is often given a small saving per foot of duct. Manholes should be not over 400 ft. apart as a general rule. The minimum practical size for a main-line manhole is about 3½ ft. by 4 ft. by 5 ft., limited to conduits of 4 ducts or less. A 5-ft. by 6-ft. by 7-ft. manhole is considered satisfactory for an 8-duct conduit; one 5 ft. by 8 ft. by 8 ft. for a 16-duct installation, and one 8 ft. square and 10 ft. deep for 30 to 40 ducts. A growing demand exists for some type of underground construction satisfactory for use in the residential and outlying districts where the expense of a first-class conduit is prohibitive considering the small amount of business to be handled. In such a district two or four clay or fiber ducts may be laid in the ground without a concrete envelope and with or without cement or asphaltum joints, as conditions require, covering the ducts with plank or other strong material to distribute the street load and protect the

ducts from injury. A conduit of this type can be laid near the surface and requires only small and relatively inexpensive manholes, the cost being rarely over 50 per cent of the cost of a first-class conduit with concrete envelope.

Mr. Harrington emphasized the importance of laying conduit to a straight line and grade, avoiding sharp bends. Drainage and ventilation may be considered together. In one or two localities all manholes have been equipped with drains and a pipe run into each manhole to supply air under pressure, the openings in the pipe in the manholes being regulated to produce an air pressure in the manholes slightly in excess of the pressure of gas in the adjacent ground. This system is effective, but too expensive for ordinary use. The plan of making all manholes reasonably tight, waterproofing when necessary and providing against gas by plastering the walls thoroughly and closing all ducts at the manholes is usually successful. With increasing sentiment for better conduits, including skilled supervision of their installation, more attention will be paid to waterproofing and ventilation.

MULTI-VOLTAGE SYSTEM FOR CHARGING ELECTRIC AUTOMOBILE BATTERIES.

At the regular meeting of the Electric Vehicle Association of America held in New York on March 26 Mr. J. F. Lincoln, of Cleveland, presented a paper entitled "Efficient Charging of Electric Automobile Batteries." In the prefatory remarks the author drew attention to the disadvantages of the single-voltage system of charging through a rheostat with losses ranging from 5 to 80 per cent, and also to the drawbacks of charging batteries in series, especially when the batteries are not in an equal state of discharge. Mr. Lincoln, moreover, contended that the cost of tube breakage in the usual garage militated against the use of the mercury-arc rectifier for charging purposes. In the estimation of the author, the ideal charging system would, because of the wide diversity of voltages employed in commercial cars, require a multi-voltage source of supply. In series with the battery there should be placed a small ohmic resistance, which will automatically cause the charging rate to decrease as the charge goes on, consequent on the rising voltage of the battery. It will also be necessary to have the rheostat so arranged that any charging rate can be given to the battery, from 5 to 60 amp, without danger to the rheostat. As an added advantage to such a system, arrangement should be made so that the state of charge and rate of charge of each battery in the circuit can be read from a central panel. To fulfil these requirements the company represented by the author has devised a number of special pieces of apparatus especially adapted to the work. These are primarily, where the supply is alternating current, a motor-generator set, the generator being wound for tensions of 70 and 105 volts. Directly connected to the generator is a small double commutator booster, whose fields are given constant excitation from the 105-volt generator. The two windings on the armature are arranged to deliver 5 volts. With such an outfit it will be possible to add to or subtract from the voltage of the main generator, and in this way voltages ranging from 65 to 115 in 5-volt steps may be obtained. Moreover, the positive or negative boost is taken from opposite sides of the small booster, so that the rating of the booster is very small in comparison with the rating of the main generator. The author contends that with a charging outfit such as described all of the usual batteries now in operation can be charged direct from the system without a loss which will exceed a maximum of 5 volts, and that in actual practice the loss will average considerably less than 2 volts. This would mean a saving of from 2 to 50 per cent over the single-voltage system and would also permit batteries to be charged in parallel, which is quite important. Another important feature is that, since there is a very small resistance in series with the battery, the charging rate will automatically taper off. The system has also commercial advantages, which the author described at length.

The paper was discussed by Messrs. S. E. Harris, T. H. Schoepf, Q. A. Brackett, R. E. Russell, Bruce Ford, R. M. Lloyd and C. A. Graves. Mr. Harris contended that in the New York Edison Company's practice a tapering charge may be obtained without touching the rheostat, and that the rheostatic method with forty-two cells on standard central-station direct-current circuits gave an efficiency of about 90 per cent, whereas the efficiency with motor-generator sets is much below this.

Mr. Schoepf maintained that for large garages two motor-generator outfits, each capable of delivering tensions varying from 60 to 125 volts through field regulation, were preferable to the scheme proposed by the author.

Both Mr. Brackett and Mr. Russell outlined in great detail the advantages of the mercury arc rectifier over the motor-generator set, especially for private installations, due to its higher efficiency and the ability to cut off the rectifier automatically from the circuit when the charging is complete. Mr. Russell maintained that there are approximately 10,000 rectifiers at present in use in private garages, and while there are 800 rectifiers in use in the city of Cleveland at the present time, there are only 250 motor-generator sets in use in that city.

Mr. Lloyd, of the General Vehicle Company, favored the rheostatic method of charging with a full-size battery from the 115-volt system, on the score of simplicity.

In answer to questions, Mr. Lincoln pointed out that up to 1912 the greater number of pleasure vehicles on the market were equipped with thirty cells of battery or less. He also drew attention to the fact that the ordinary mercury-arc rectifier is not suitable for use in connection with Edison batteries. The representatives of the General Electric and Westinghouse companies present stated that a mercury rectifier set is obtainable for use with the Edison battery.

TECHNICAL TRAINING FOR WESTINGHOUSE EMPLOYEES.

Having an active membership of about 750 men, the Westinghouse Club, Wilkinsburg, Pa., is conducting an important educational work among the employees of the Westinghouse Electric & Manufacturing Company, the Westinghouse Air Brake Company, the Westinghouse Machine Company and the Union Switch & Signal Company, which companies provide the clubrooms and supervise the general organization. Although membership of the club is open to any male employee of the companies, yet about one-half of the membership is composed of college graduates in apprenticeship work.

During the first three nights of each week meetings are held of certain technical sections composed of from twelve to seventy-five men studying under the direction of leaders selected from the engineering and sales staffs of the companies. Among the subjects covered in this way are switchboard engineering, sales, railway projects, incandescent lamps, transformers, power-house equipment, detail and supply, illumination, railway-motor control, industrial-motor control, factory testing, railway signaling equipment, central-station development, brake equipment, industrial motor applications and works management. The club also provides weekly lectures of a semi-technical nature by well-known engineers and educators. On almost every Saturday afternoon trips are made to notable industrial establishments in the Pittsburgh district, including rolling mills, tube mills, blast furnaces, coal mines, cement mills, glass mills, locomotive and car works, oil wells, power stations,

machine shops and many other plants of interest to engineers for which this district is noted.

The educational work of the club does not take the place of the regular training required of all engineering apprentices, but is supplementary thereto along the lines in which the men are most interested.

PROTECTION OF TRANSMISSION CIRCUITS AND APPARATUS.

The general subject of method and means for protecting transmission circuits and apparatus from overloads, short-circuits, internal and external disturbances has been discussed at three meetings of the American Institute of Electrical Engineers, held in Boston, Chicago and New York.

CHARACTERISTICS OF PROTECTIVE RELAYS.

At a special meeting of the Boston Section of the American Institute of Electrical Engineers held at Tufts College, Mass., Mr. G. A. Burnham, electrical engineer of the Condit Electrical Manufacturing Company, Boston, read a paper on "The Characteristics of Time-Limit Relays for Selective Action." The author pointed out that the time-limit relay is the most important piece of auxiliary apparatus in the equipment of any transmission system, protection of apparatus and continuity of service both depending upon it. The increase of capacity and changes of design of generating units and transmission systems within recent years have brought about a condition whereby the time-limit relay of a few years ago will not meet the present conditions. Two classes of time-limit relays are used extensively for the selective operation of circuit-breakers on transmission systems—plain overload and reverse power. The plain overload relay or the reverse-power type may have an inverse action in which the greater the current the less the time required for operation, or the so-called definite action in which the time of operation is independent of the current. The inverse time-limit relay would handle the situation well if an inverse curve of the proper type could be obtained. The inverse time-limit relays of the past had a curve of such a character that three or four times full-load current would cause their operation almost instantly. In any well-designed system of distribution such an overload should not be disastrous if held on for two or three seconds. Ten to twenty times full-load current is often reached on severe short-circuits. Hence a relay operating practically instantly at four or five times full-load current interrupts the service in the face of the ability of the generating and transforming equipment to withstand the stresses imposed.

Mr. Burnham said that to obtain any degree of accuracy a great amount of torque must be available in comparison with the amount of power required to operate the timing mechanism; but, on the other hand, the relay must be designed to consume very little energy, as the supply usually comes from the secondary of a series transformer. The power-factor should be high in order that the relay when operated in series with instruments may introduce the minimum error. The author then presented details of a motor-operated relay of recent design which presents many novel features. An armature is mounted in ball bearings and arranged to rotate in a bipolar field. The field frame is split, the upper pole being permanently fastened to the main casting, and the lower pole is fastened to a system of pivoted arms having contact with a compression spring used in current calibration. The fields are connected in multiple. Current passes through these coils from a series transformer, and when of sufficient value to overcome the spring tension the lower half of the movable field is attracted to the top. When the magnetic pull is sufficient to raise the lower half of the magnetic circuit a metallic pin closes stationary contacts, transforming the electromagnet into a repulsion motor and resulting in the rotation of the armature. The current in the armature is induced electrically. The load on the motor is practically constant, and with a different current value in the field up to a certain point the induced current in the armature will increase in proportion to the current in the field coils. The torque of the motor is increased, and with a constant load the speed will increase with an increase of torque. As the distance is fixed through which the contact travels, the time required for it to close the circuit and open the breaking device will vary inversely as the speed or current, giving an inverse curve.

Mr. Burnham said that it has been a comparatively easy matter to produce an inverse curve, but a difficult problem to produce a curve in which the first part was inverse and the last part definite, and to the author's knowledge there was never a relay available with these characteristics until the present type was placed on the market. In order to produce the definite part of the curve, the windings are so proportioned with relation to the magnetic circuit that it is saturated at whatever point it is desired to have the definite part of the curve start. By the saturation of the iron, even if the amount of current increases in the field coils, there is practically no increase in flux and hence no increase in torque; therefore the speed and time remain constant beyond the point of saturation. The time-element is inherent in the design of the relay itself, and no external control magnets are required for the motor. The shape of the curve, the current calibration and the time control are all accomplished by the peculiar design of the motor, and no co-operating apparatus such as individual circuit-closing relays or shunts is required. The change of time is simply effected by shortening the distance through which the contact travels, and the general shape of the operating curve is not affected.

Tests of the relay at Chicago show that there is an average variation throughout the entire curve of only 0.074 second, and the average variation in the definite part of the curve is only 0.046 second. Although the maximum current indicated in the test was 50 amp, recent tests at Philadelphia show that even at 90 amp there is no change whatever in the time of operation. The resetting qualities of the device are extremely good because current calibration is obtained by spring compression, maintaining a constant air-gap, instead of employing gravity control with a varying air-gap. The smaller the air-gap the better the resetting qualities. The resetting occurs when the current has decreased 20 to 25 per cent below minimum current setting. Creeping cannot occur, as the armature circuit is kept open all the time until the minimum current setting point is reached. The torque and power of the motor are great compared with the friction load, and as the motor is much more efficient than the solenoid type of relay, together with the absence of any retarding device requiring power for operation, the energy consumption is very small. At a load of 3 amp the relay consumed 6.6 volt-amp, and at 5 amp, 19-volt-amp. A solenoid relay consumed 27 volt-amp at 5-amp load, and the motor-operated relay, 18 volt-amp. The ampere-turns are reduced by the elimination of the retarding elements, only twenty convolutions of wire being required in the field of the relay. This results in low reactance and high power-factor, which is very desirable when a relay and instruments are operated from the same transformer. At 3 amp the power-factors were 37 per cent for a motor-operated relay and 30 per cent with a solenoid, the corresponding figures at 5 amp being 42 and 31 per cent. On account of the saturation of the magnetic circuit the magnetic pull and mechanical impact are no greater at 5000 per cent overload than at 400 per cent. No particular curve or setting is best for all conditions, but the relay having the greatest accuracy and performance which will allow of close selective setting will reduce

the maximum time to the least possible value for short-circuits, and this is a most important and desirable feature for the protection of systems of large capacities.

PROTECTION OF CIRCUITS AND APPARATUS.

Mr. James Lyman read a paper entitled "Protection of High-Tension Power Circuits and Apparatus" at a joint meeting in Chicago of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers.

The author outlined the operating characteristics of instantaneous relay, and showed it to be disadvantageous in not discriminating between overload and fault in the system and in not being selective in its action. For selective service the inverse type of relay and the reverse-power type of relay have been developed. The inverse-time-limit relay operates with a rapidity varying inversely with the overload, and hence is slightly selective and somewhat discriminating.

For perfect performance a relay should accurately discriminate between a fault and an overload and should disconnect a faulty circuit before other circuits become damaged. The author stated that the Merz-Price protective gear, named after its inventor, performs these functions. Any feeder or apparatus protected by it is promptly cut out of circuit simultaneously at both ends, while it is not affected by any healthy overload of energy flow in either direction. The system is based on the principle that, while normally the amount of current leaving a conductor at one end is equal to that which enters it at the other, as soon as a fault or leak develops this equality disappears. Series transformers are at both ends of each conductor of the cables, their secondaries being connected in opposition by means of pilot wires with relays in circuit. When, owing to a fault, the balance between the two sets of series transformers is upset, and in consequence a current flows through the pilot wire, the switches are tripped at both ends of the cable. In this way, as a fault affects only the particular pair of series transformers on either side and immediately adjacent to it, causing a current to flow along the pilot wire connecting these transformers, the faulty section is isolated without disturbing any other. There are several ways of creating the balance of opposed forces applicable to various sets of conditions, but the principle remains the same in all. With this system it is possible to obtain the full advantages of a duplicate supply, because the whole network may be kept continuously alive in the assurance that a faulty cable or other piece of apparatus will be isolated without in any way affecting the healthy duplicate, which will be thus left intact and automatically take the load without even momentary cessation of supply. No matter how much current flows through a healthy section—that is, a section in which there is no fault—the balance in the pilot-wire circuit controlling such section will not be affected.

The one objection to the Merz-Price protective gear is the cost of the pilot cable, which is from $800 to $1,000 per mile, not including ducts. The considerable expense of the pilot cable will probably limit the use of the device to very important circuits from generating station to substation and for tie lines between stations. It has been in successful operation in England for more than two years, the principal installation being on the Northeast Coast Power Company's system in the vicinity of Newcastle, where more than 1000 sets of protective gear are in operation, giving perfect protection and uninterrupted service.

Discussion.

The discussion related mainly to the Merz-Price protective gear for high-tension apparatus, to which the main body of the paper was devoted. The consensus of opinion was that this apparatus exhibits successful and original engineering, worked out particularly for the needs of such systems as that of the North East Coast Power System of England, but that it did not necessarily follow that it was well adapted for the needs of large producers of electrical energy in the principal American cities.

Mr. R. F. Schuchardt, electrical engineer of the Commonwealth Edison Company, praised the paper and said it was the first time that a detailed description of this construction had been presented at an American meeting. The oil switch is a very important feature of power-apparatus protection, but it is a question whether instantaneous action is desired. The pop valves used by the Commonwealth Edison Company on the air dash-pots of the inverse-time-limit overload relays of the 25-cycle feeders were installed several years ago, primarily to insure the reliability of the relay. After they were installed a conduit relay was brought out, and now there is said to be available a relay which is really selective. The Merz-Price system is ingenious and excellent in its proper place. However, it is not a cure-all for troubles of large systems. It has some advantages, and one is the prevention of the development of a fault. However, switches can be designed to handle most cable break-downs. The principal disadvantage of the system is its high cost. It also adds complication, which is a serious point. It may be dangerous to put entire reliance on it. The need for separate series transformers of special type is another objection. It is possible, also, that a break might occur in the pilot-wire circuit without being detected; and, furthermore, the switch gear and busbars are absolutely unprotected, being outside of the zone of protection. This objection is met, however, by the introduction of the iron-clad type of switch.

Mr. Schuchardt pointed out that the conditions of the Newcastle-on-Tyne system are quite different from those in large American cities. The comparative freedom of large European systems from break-down troubles is due largely to the higher grade of cable employed. American manufacturers do not seem to be able to produce cable equal to that insisted upon by the English engineers. Mr. Schuchardt praised the work of Messrs. Merz and Price, but said that in this country what seemed to be most needed is a proper, satisfactory, reliable reverse-power relay. The use of this device, together with the selective relay now promised, should be sufficient to protect high-potential electric systems.

Mr. Peter Junkersfeld, of the Commonwealth Edison Company, sketched the development of high-tension protective apparatus for the underground transmission and distribution system in Chicago. For the conditions encountered in the North East Coast Power System of England the Merz-Price relay system works out very well and displays sound engineering judgment, but that is an interconnected system, with a large number of comparatively small substations, and the energy flows both ways at different times. The Newcastle-on-Tyne people have worked out their own problems, but the conditions are quite different in American cities. The speaker praised the ironclad switch gear described in the paper, and he said that that type of protection for use in power houses and substations is now being introduced in this country.

Mr. Frank F. Fowle also praised the ironclad switch gear, and among other things pointed out that it prevented injuries to persons and bade fair to result in the saving of life.

Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, detailed the practical difficulties encountered by that company in its high-tension, alternating-current work. The protection of lines above 9000 volts still leaves something to be desired. It seems probable that ultimate relief will be attained by better insulation rather than by any kind of protective devices. The latter are "contraptions," however efficient they may be, and simplicity in power houses, transmission lines, substations and distribution is to be desired greatly. Mr. Abbott

agreed with Mr. Schuchardt that a higher grade of cable is needed in this country.

Mr. D. W. Roper, of the same company, described the instantaneous overload relays, which are selective, used by the Interborough system in New York. These have certain advantages, but they apply only to cables that break down to ground and not to cables that break down between phases. The Merz-Price system described in the paper would require about double the number of series transformers needed in a radial system such as is used in Chicago. The series transformer is a vulnerable piece of apparatus, and the number used should not be increased more than necessary. In Chicago fully half of the troubles on underground lines are due to external causes. If the Merz-Price system were used these accidents might affect the pilot wires also.

Mr. George H. Lukes, general superintendent of the Public Service Company of Northern Illinois, spoke of substation construction. Here less expensive construction and greater simplicity are needed. Mr. Lukes expressed his interest in some of the substations with "brick switchboards," used on the Newcastle-on-Tyne system. In a scattered electric-service system, where the demand on many substations is small, the substation expense becomes important. In this country it usually costs between $5,000 and $6,000 a year to maintain a small substation such as is used in commercial practice. Half of this goes for labor and maintenance and half for fixed charges. This expense may be cut down, perhaps, by developing substation apparatus not requiring attendance.

Mr. H. B. Gear, of the Commonwealth Edison Company, said that the average output of the substations of the North East Coast Power System seems to be about 800 kw, while in Chicago it is about 2000 kw. In the latter city, therefore, it would not be practicable to loop the substations on a ring system, owing to the limited carrying capacity of the cables. Mr. Junkersfeld added that out of 150 substations in the North East system about 100 had less than 200 kw connected load.

Answering various questions and in closing Mr. Lyman made some additional points. He explained why the ordinary series transformer is not well adapted for the Merz-Price balanced-voltage system of protecting cables. Turning to another phase of the subject, he said that a variation of 5 per cent in voltage is permitted under the conditions of the Newcastle system. This would not be allowed in American cities, and permits the absence of voltage regulators and some instruments, making possible greater simplicity in substation design. Many of the substations of the North East system have no operators. Usually the small substations in this class are for the individual needs of large consumers. Aerial circuits are protected by the Merz-Price system in some instances. Here the pilot wire is suspended from messenger wire. The system is not to be recommended for all large commercial power installations. It has merit in certain conditions, as where heavy power is transmitted a comparatively few miles and where absolute reliability is desired. The great advantage of this system of protection is that a large system may be operated safely in parallel by its use. It also increases the reserve capacity of the circuits leading from the substations. Furthermore, it does away with emergency or reserve cables. As to complication, perhaps as much apparatus is cut out as is added. Engineers of this country are apt to think in terms of radial transmission to substations, and should keep open minds for improvements such as the Merz-Price system seems to offer under certain conditions.

PROTECTION OF HIGH-VOLTAGE SYSTEMS.

At a meeting of the Institute held in New York on March 8 Mr. E. M. Hewlett presented a paper entitled "Characteristics of Protective Relays," and a paper by Dr. C. P. Steinmetz entitled "Some Problems of High-Voltage Transmissions" was read by Mr. C. W. Stone in the absence of the author.

In the paper by Mr. E. M. Hewlett were described the chief characteristics of protective relays necessary for the automatic and selective action of circuit-breaking and switching devices connected to an electrical distributing system. The author stated that it is desirable to consider separately the various conditions to be met by a relay, and then to select the relay with the most suitable characteristics. No one relay will satisfactorily comply with all operating conditions. In a generating station it is of the utmost importance to keep the generators in service, because the possibility of trouble arising between the generators and the busbars is rather remote. The switches may be either non-automatic or equipped with definite-time-limit relays having approximately a straight-line characteristic. The relay should be arranged to trip the generator switch only as a last resort, after the automatic switches more remote from the generators have failed to isolate the trouble. It is often desirable to have an indication of reversal of energy flow in the generator circuits without automatically tripping the generator switches. To meet this condition use may be made of the so-called reverse-current time-limit relay, which will operate on small power reversals without indicating direct overloads of short duration. In order to isolate transformers which may develop internal short-circuits, use may be made of instantaneous relays sufficiently sensitive to operate on a small reversal of power in order to minimize the damage. Where distributing feeders are run in parallel from central-station busbars the feeders must be cut out selectively and the different sections in series must also be selectively cut out, so as to isolate the section and feeder in which the trouble occurs. Use should be made in this connection of inverse time overload relays having the proper characteristics. Where two transmission lines are operated in parallel in such a way that either of them can carry the entire load under emergency conditions, it is advisable to install an instantaneous differential balanced relay in the indicating line of each substation in the series. This relay should be arranged to open the line when each reversal of power occurs, and at the same time to lock the relay in the other line to prevent its operating by reason of overload.

In his paper Dr. Steinmetz called attention to the fact that the emf impressed upon a number of similar disk suspension insulators in series does not divide equally between the disks, and stated that, in order to extend the insulating possibilities of the suspension insulator type far beyond the voltage now contemplated, it will be necessary to use insulator disks of graded capacity, so that the disk nearest the line has the highest and that nearest the ground the lowest capacity. The capacities of the successive insulators of the series should be so proportioned that the product of the capacity and the total displacement current of each insulator disk will be proportional to its disruptive strength. However, the real limitation in transmission voltage at the present time relates to the escape of electric energy into the air directly from the conductors. By the use of large aluminum conductors, and possibly even with separate tower lines for each separate conductor in order to obtain a great distance between individual conductors, it may be possible to reach 250,000 volts for transmission, and possibly even higher voltages by using special designs of line conductors. Atmospheric lightning has practically ceased to be a formidable enemy of long-distance transmission, following the introduction of the aluminum-cell lightning arrester for protecting the station and overhead grounded wires for protecting the transmission circuits.

At low voltages the internal distributed capacity of the transformer is a negligible factor, but at very high voltages the electrostatic capacity of the transformer becomes appreciable, the high-potential coil of the transformer rep-

resenting a circuit containing distributed capacity, inductance, resistance and conductance, just as does a transmission line. In view of the different numerical values of the constants in the transformer from those in the transmission line, cumulative oscillations are more liable to occur in transformers than in transmission lines. High-frequency oscillations may originate in the high-potential coils of the transformer, or oscillations originating in the transmitting line may enter the transformer and then in passing over the transition point from line to transformer may increase in voltage, while decreasing in current by the transformation ratio of the transition point. The danger to which the transformer is exposed by high-frequency disturbances from the transmission line is, therefore, not limited to the end turns, but damage may be done inside of the transformer at any point where a wave crest forms. Inductance interposed between the line and a transformer keeps line disturbances out of the transformer, but it also reflects disturbances which originate in the transformer back into it, and thereby increases their voltage and destructiveness. It, therefore, becomes necessary to add to the series inductance a device which by-passes the disturbances which come from the transformer, but does not allow line disturbances to pass into the transformer.

In high-voltage, long-distance transmission lines the capacity current of the line becomes considerable and may reach values even higher than the normal full-load current of the system. This current overheats the generator, although it represents almost no power consumed. On account of the capacity current in the line, the voltage at the receiving end varies considerably between no-load and full-load, even assuming constant voltage at the generator terminals. In case the load upon the transmission line suddenly changes from overload to no-load, the turbines, relieved of their load, momentarily accelerate and increase the generator voltage. The capacity current of the line reacts to magnetize the generator field, thus further increasing the generator voltage, and the rise in voltage at the receiving end of the line may reach 75 per cent of the normal value. The most effective way of protecting against this sudden rise of voltage when the circuit-breaker is opened at the receiving end of the line seems to be not to open the circuit suddenly but to arrange it so that an inductive load may be thrown into the circuit by opening all the circuit-breakers and thus keeping the voltage within the proper limits.

Discussion.

In opening the discussion on the papers, Mr. David B. Rushmore, chairman of the high-tension transmission committee of the Institute, mentioned the fact that the Lehigh Coal & Navigation Company is beginning the installation of the first steam station in the East intended solely for the purpose of transmitting energy directly from the coal mines. This station will be in easy transmission distance of both New York and Philadelphia. It is being designed for an ultimate equipment of 120,000 kw. The energy will be used initially largely for driving cement mills and for lighting the towns through which the transmission lines will pass in reaching these mills. He stated that a hydroelectric plant is soon to be placed in operation in Virginia to transmit energy to the Pocahontas coal fields. He called attention to the 140,000-volt transmission system now nearing completion in Michigan. He called attention also to the proposal which is now being considered seriously of a New York state-owned distributing system for supplying energy to municipalities according to a plan somewhat similar to that employed in Ontario.

Mr. C. S. Ruffner remarked that most of the relays coming under his notice had been installed in the hope that they might accomplish some good function, but were actually operated either by disconnecting them from the control circuit or by plugging their connections in some other way. This condition does not show that relays are unnecessary, but rather that in the past they have been used indiscriminately and in places where they should not have been employed. In Colorado systems use is being made of a balanced type of relay with excellent results where two generating stations feed energy into a single substation. After the relays were installed their action was so accurate that in several cases they have disconnected defective lines without allowing synchronous motors to fall out of step.

In commenting on Dr. Steinmetz's paper, Mr. Ruffner stated that an observation of about 200 cases of lightning disturbances during one season showed that in each case where the transmission line was affected the insulator disk nearest the conductor was damaged, usually being punctured, and in about 25 per cent of the cases in which the insulators were damaged the disk nearest the ground structure suffered only by reason of the ensuing arc; none of the latter disks were punctured. He said that he could recall no occurrence of an arc due to the failure of any apparatus by reason of over-voltage which could not be very clearly explained by the presence of high frequency, combined with change of circuit constants at the point of break-down, as mentioned by Dr. Steinmetz.

Mr. F. W. Peek, Jr., stated that even with the known limitations imposed by the corona loss it is possible to operate at the present time with a transmission emf of 200,000 volts, by using a conductor only 1 in. in diameter with a spacing of perhaps 15 ft. With long distances and high voltages, difficulty would be encountered by reason of the presence of the excessive charging currents which may overload the generators to such an extent as to destroy them, or impair the voltage regulation sufficiently to damage the receiving apparatus. Mr. Peek predicted that the limit to which energy will be transmitted in the future will not be set by the maximum voltage that can be reached, but rather by the local demand for the energy. Where all the energy is consumed near the generating station there will be no long-distance transmission.

Mr. Percy H. Thomas expressed the opinion that, even independent of the distance of transmission, it is economical to use high voltage if a large amount of power is to be transmitted, both by reason of the saving in copper and on account of the production of a large leading charging current to balance the lagging current of the consuming devices.

Dr. A. E. Kennelly reported the results of observations made upon a 650-mile artificial transmission line operated at from 25 cycles to 400 cycles per second. At 60 cycles the rise of voltage at the distant end with practically sine wave at the home end is about 66 per cent. With a frequency of 400 cycles per second, the rise in voltage may be ten times the voltage applied. Thus at 60 cycles, with a relatively simple multiple harmonic, such as a seventh, a 10 per cent ripple in the emf wave would be able to produce perhaps a 100 per cent increase in voltage added in vector quadrature, thus giving a 41 per cent voltage rise.

Dr. A. S. McAllister called attention to the inaccuracy in the common designation of the apparatus known as the "reverse-current" relay. This device is employed in an alternating-current circuit and operates not with the reversal of current but with the reversal of the flow of energy, and hence is a "reverse-power" relay rather than a reverse-current relay.

Mr. Farley Osgood said that the proper operation of a relay depends largely on its being carefully watched, carefully tested and, most important of all, carefully and frequently cleaned. The relay is an excellent device when it is in good condition, but is an enemy to proper performance when it is in bad condition.

Mr. W. S. Murray outlined an interesting problem in transmission encountered in the operation of single-phase railways. The New York, New Haven & Hartford Railroad now operates without any substations 535 miles of single-phase transmission line, with twenty-eight wires in

one direction and forty wires in another direction. The company is contemplating increasing its equipment at the Cos Cob station from about 16,000 kw to about 35,000 kw. The system is operating at present at 11,000 volts two-wire, and arrangements are being made to operate it without change of insulators at 22,000 volts three-wire. The track will be used as the neutral of the three-wire system, and the eastbound contact wires will be the outgoing circuits and the westbound the incoming circuits of the outer leads.

Mr. C. O. Mailloux, who was introduced as the man who made the first circuit-breaker, called originally an electromagnet fuse, explained that this circuit-breaker was used on the first electric car which ran in New York City in 1887. The circuit-breaker was of the relay type, and was not successful because it followed too closely the idea of the telegraph relay. The relay type of breaker has been gradually improved, until at the present time it renders reliable service when it receives proper attention. It is destined to play an even more important part in the future in supervising the operation of large electrical systems.

AMERICAN RAILWAY ENGINEERING ASSOCIATION.

With an attendance of about 350 members and a much larger number of visitors, the American Railway Engineering Association conducted its thirteenth annual convention in the Congress Hotel, Chicago, on March 19, 20 and 21. As is the usual practice of this association, the work of the convention was done through the consideration of the reports of various committees. Nearly all of these related to subjects which are not of direct electrical interest, but a few have a bearing on electrical work, and therefore a brief summary of the electrical features of the convention is given below.

On the day before the convention there was a stated meeting of the Railway Signal Association, at which progress reports were presented. Signaling subjects also were discussed at the first day's session of the engineering association. Majority and minority reports were presented from the committee on signals and interlocking, and a table of insulation resistances for various sizes of wire was adopted.

In his annual address, President W. C. Cushing, of the Pennsylvania Lines, Pittsburgh, remarked that the work of introducing electric service on steam railroads was continued last year, mentioning particularly the electrification of the Hoosac Tunnel. Lately the New York, New Haven & Hartford Company has made known its plan to change the operation of its main line from Stamford to New Haven, Conn., to electric traction at an early date, the estimated cost being $7,000,000.

REPORT OF COMMITTEE ON ELECTRICITY.

The report of the committee on electricity was devoted to two subjects—(1) railroad clearances of electrical equipment and (2) transmission lines and crossings. In relation to clearances, the following definition of third-rail gage was adopted: "Distance, measured parallel to plane of top of both running rails, between gage of nearest running rail and inside gage line of third-rail." A diagram was adopted showing equipment clearance lines, clearance lines for permanent-way structure adjacent to third-rail, and third-rail structure clearance lines.

In the presentation of the report of the committee on electricity, the greater part of the time was taken up in the consideration of the specifications for overhead crossings of electric lighting and transmission lines which were presented by the committee. Mr. George W. Kittredge, chief engineer of the New York Central, is chairman of the committee, and Mr. R. D. Coombs, consulting engineer, of New York, is chairman of the sub-committee on transmission lines and crossings. This sub-committee has been working in conjunction with a joint committee representing the National Electric Light Association, American Institute of Electrical Engineers, American Electric Railway Association, Association of Railway Telegraph Superintendents and representatives of large telegraph and telephone companies. The report of the joint committee and the report of the committee on electricity of the American Railway Engineering Association agree in the main, although there are points of divergence in a number of particulars. The specifications for overhead crossings as reported by Mr. Kittredge's committee were taken up paragraph by paragraph. In every instance except one where there was a difference between this report and that of the joint committee the paragraph of the joint committee was adopted, in deference to the wishes of the other associations mentioned. In one case, however, the steam-railroad men stood immovable, and this was in relation to paragraph 18, in which Mr. Kittredge said that the committee felt that it could not adopt the language of the joint committee's report. This paragraph relates to conductors, and as adopted by the American Railway Engineering Association reads as follows:

"18. Strain insulators shall be used in guys from wooden poles carrying any power wire of less than 6600 volts, provided the guys are not through-grounded to permanently damp earth. Strain insulators shall not be used in guying steel structures nor required on wooden poles carrying wires all of which are 6600 volts or more, provided the guys are through-grounded to permanently damp earth."

The joint committee's corresponding paragraph is the same, with the exception that the words "provided the guys are not through-grounded to permanently damp earth" are omitted in each of the two sentences of the paragraph. In every other case the specifications of the joint committee were adopted, the steam-railroad men waiving their own specifications, which are in some particulars parhaps a trifle more rigid. It is understood that in the conferences between the representatives of the American Railway Engineering Association and those of the joint societies the latter said that they would make an effort to have their specifications amended in accordance with the railroad men's wishes about paragraph 18, provided all their other specifications were adopted without change.

Mr. Coombs read a letter from the joint committee of the National Electric Light Association and the other associations pleading for uniformity and unanimity of action and asking that the joint committee's specifications be adopted, revision to be made later if found necessary. There was some debate on this subject. Mr. E. B. Katté, of the New York Central Railroad, urged that the American Railway Engineering Association stick to its own specifications, which he thought were rather better than those of the joint committee. Mr. Coombs urged co-operation with the joint committee, and Mr. L. C. Fritch, of the Chicago Great Western Railway, another member of the committee, also pleaded for uniformity. The association adopted the views of Mr. Kittredge, Mr. Coombs and the majority of the commission.

NATURAL RESOURCES AND WOOD PRESERVATION.

The committee on conservation of natural resources presented an interesting report relating to forestry, coal resources and fuel-oil resources in this country and Canada.

In regard to wood preservation, the conclusions recommended by the committee on that subject related almost entirely to the treatment of ties. The committee recommended that in addition to the standard specifications for creosote oil two others might be used where the higher grade of oil cannot be procured. These added specifications relate to a No. 2 grade of creosote oil and a No. 3 grade. It was made clear that where it is necessary to purchase grades Nos. 2 and 3, it should be understood that a greater quantity of creosote oil per cubic foot of timber treated should be used. There was a considerable debate on the

adoption of this report, but finally the recommendation of the committee was upheld.

STORAGE BATTERY IN RAILROAD WORK.

Mr. L. C. Fritch, chief engineer of the Chicago Great Western Railroad, prepared a paper on "The Storage Battery in Railway Service," which, while not read before the convention, became a part of the printed proceedings. In this paper Mr. Fritch gave a brief outline of the theory and principal characteristics of the storage battery and also described some of the uses of the battery in railroad work. Both the lead cell and the Edison storage battery were described. The applications mentioned were in relation to train lighting, signaling, drawbridge operation, station lighting and storage-battery traction. Considering the last-named subject, Mr. Fritch mentioned the use of storage-battery street-railway cars by the Third Avenue Railroad Company, of New York, and continued: "Some experiments are also being made with storage-battery cars on branch lines of steam railroads where the traffic is light and only infrequent service is maintained. It is probable that in many such situations the storage-battery car will prove to be the most economical method of providing for the passenger service from a commercial standpoint. The cost of labor and energy will be less than for locomotive operation, and the initial investment will, in many cases, be considerably less than that required for equipment with the overhead trolley, particularly where energy can be purchased from a local lighting company, at a low rate, during the hours when the lighting load is a minimum, and, therefore, no investment for additional machinery is called for."

ELECTION OF OFFICERS AND ANNUAL DINNER.

Mr. Charles S. Churchill, of Roanoke, Va., chief engineer of the Norfolk & Western Railway, was elected president of the association, and Mr. E. H. Fritch, 962 Monadnock Building, Chicago, was re-elected secretary. The annual dinner of the association was held in the Gold Room of the Congress Hotel on March 21. About 400 persons were present, and addresses by Mr. L. F. Loree, president of the Delaware & Hudson Railroad; Mr. F. D. Monk, Minister of Public Works of Canada, and Mr. Ray Morris, of New York, were delivered.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION.

The New York Public Service Commission for the First District has sent a letter to the New York Railways Company asking whether it will build the extension of its 116th Street Crosstown Line from Pleasant Avenue to the East River. There is a ferry at this point, and public convenience requires that the street railroad should connect with the ferry. Although the company's franchise covers the route clear to the river, there is a stretch of about 700 ft. between Pleasant Avenue and the river which has not been built. Commissioner Milo R. Maltbie held a hearing upon the subject, and the company claimed that the cost of the extension would be from $20,000 for a single-track to $43,000 for a double-track road; that it would get all the traffic without constructing the extension, and that the additional receipts would not be sufficient to warrant the extension. The commission, on Commissioner Maltbie's opinion, rejected this contention on the ground that "the productiveness or non-productiveness of the extension does not affect the legal obligation of the company to make the extension." The opinion intimates that if the company does not build the extension the commission will institute court proceedings to compel it to do so.

The commission has granted permission to the New York Edison Company to put into effect April 1, without the customary notice, a new tariff for tungsten lamps. The new tariff makes material reductions in the prices charged for such lamps.

The commission for the Second District has dismissed the petition of the Fredonia Natural Gas Light Company asking for permission to suspend the manufacture of illuminating gas for service in the village of Fredonia, Chautauqua County. The petition stated that the company was selling manufactured gas at an income of less than $25 a month, the cost of manufacture being about $300 a month, and that because of the use of natural gas customers had almost entirely fallen off. The petition is denied for the reason that under the statute the commission has no jurisdiction over such an application.

The commission has received a complaint from Amos Van Etten, of Kingston, stating that the New York Telephone Company made a contract to furnish telephone service in his residence at a rate of $2 a month, but that in December, 1911, the company presented to him a contract providing for a rate of $2.50 a month, which he declined to sign, and that a threat was made to disconnect telephone service at his residence, but such action was stopped by an injunction. The petition alleges that there is no necessity for an increased rate in the city of Kingston, that the service can be furnished without any loss or injury to the telephone company at a less rate, and the commission is asked to investigate the rates in that city and determine what is a reasonable and fair charge. The complaint has been served upon the telephone company and an answer required within ten days.

The commission has received an application from the Red Hook Light & Power Company asking permission to exercise the rights and privileges granted by franchises from the town boards of Milan and Pine Plains, Dutchess County, and to begin construction and installation of poles, wires and appurtenances for transmitting and furnishing electricity for light, heat and power to the residents of those towns.

OHIO COMMISSION.

The Sidney Telephone Company, Sidney, has filed a complaint with the Ohio commission to the effect that the Farmers' Telephone Company of the same place has been issuing stocks and bonds since July 1, 1911, without the consent of the commission. The complaint further alleges that the Farmers' company has been soliciting subscriptions to its stock in the village of Anna, representing that it has franchises from the village and that rates have been cut in Sidney, with discrimination in favor of the stockholders. The petition asks that no authority to make extensions be granted the Farmers' Telephone Company until an investigation is made.

A hearing on the complaint of the city of Akron against the Northern Ohio Traction & Light Company took place before the commission the latter part of last week. City Solicitor Taylor stated that the company did not operate a sufficient number of cars and that some of them ran without conductors. The trolley lines, he said, are dangerous also. Judge Rogers presented the company's side and defended the quality of the service, saying also that plans had been made for many improvements. Mayor Rockwell testified that his principal desire is to see the lines extended. Officers of the company made it clear that these extensions would be feasible if the commission grants its request to issue $2,000,000 new stock and the city gives it the necessary franchises. Decision was reserved.

MARYLAND COMMISSION.

The Maryland Public Service Commission last week received a petition from the Frederick & Hagerstown Power Company for authority to enter into contracts for the construction of power plants and the sale of the power developed, and for this purpose to issue $300,000 par value common stock of its capital of $500,000 and $300,000 first-mortgage bonds. The commission, after considering the

petition last week, set a hearing for Monday, April 8. The proposal set forth by the new power company, for which authority is asked of the commission, is to enter into an agreement with the Frederick Railway Company and the Hagerstown Railway Company whereby all the power dedeloped by the new company's power plants is to be furnished to the two railways for twelve years for certain considerations.

In its answer to the complaint of the Patapsco Electric & Manufacturing Company, filed last week with the commission, the Baltimore County Water & Electric Company denied that it is controlled in any way by the Consolidated Gas, Electric Light & Power Company, for the purpose of restraining the growth of the Patapsco Company. The answer, which was filed by Mr. Albert W. Wehr, president of the Baltimore County company, denies each of the specific allegations made in the complaint of the Patapsco company, of which Mr. Victor Bloede is the president, and charges that the Patapsco company in 1902 and 1907 lost the contracts for county lighting by reason of not being the low bidder. In answer to the contention that his company has been guilty of rate discriminations between different sections of the county, Mr. Wehr said that the difference in the rates is due to the difference in the kind of service and not to the competition of the Patapsco company. This is explained by the fact that at Catonsville there is a mercury-rectifier outfit, but none at Highlandtown; it is added that the Baltimore County Company plans to install such a system at the latter place and several others in the near future. When the hearing was continued later in the week, President Bloede took the stand and was examined for several hours in reference to his own rates by Vice-president Wagner of the Consolidated company. Finally Mr. Bloede admitted that there is a variance in the price per kilowatt-hour charged by the Patapsco company, but declared that the difference is proportioned to the amount of energy consumed.

In order to pay off existing indebtedness and to make needed improvements to its plant, the Easton Water Company, of Talbot County, has applied to the commission for permission to issue $45,000 in 5 per cent general-mortgage bonds, maturing in twenty years. The company has outstanding $30,000 in bonds and $8,000 floating indebtedness. The hearing on the application will be on April 12.

DEATH OF PROF. ANTONIO PACINOTTI.

Prof. Antonio Pacinotti, original inventor of the direct-current dynamo with its commutator and of the ring and toothed types of armature, died at Pisa, Italy, on March 24. Professor Pacinotti was on Jan. 2 elected an honorary member of the American Institute of Electrical Engineers, and recently informally acknowledged that distinction by sending a signed portrait to the members who proposed his election. The engrossed certificate of membership was, however, only recently forwarded, so that his death prevents formal acknowledgment of election.

Professor Pacinotti was born in Pisa, Italy, June 17, 1841. Under the direction of his father he early began the study of electromagnetism, and by the time he was seventeen years of age had the principles of the direct-current generator well in mind, constructing in 1860 the celebrated machine which ten years later was reinvented by Gramme. After three years of experimentation with his models, Pacinotti published an illustrated description of his dynamo in the *Nuovo Cimento* in 1864, but this received little attention at the time. The machine described by the young Italian embodied for the first time the ring armature with its symmetrically grouped coils closed upon themselves and connected to the bars of a commutator, the brushes of which delivered practically non-fluctuating current. In 1862 Pacinotti was appointed to the assistant professorship of astronomy at Florence, and, having to renounce carrying out his electrical experiments on the enlarged scale he had planned, then prepared the *Nuovo Cimento* description of his generator, already mentioned. In 1864 he received the professorship of applied physics at Bologna and in 1873 was appointed professor of physics at Cagliara.

At the Vienna exposition in 1873 he exhibited his dynamo model made in 1860, and for the first time received wide credit for his achievement, interest in which had meanwhile been awakened by the independent invention of the ring armature by Gramme in 1870. A medal of progress was granted Pacinotti at Vienna, and other awards of honor were given him in 1881 at Paris, where his early machine was also exhibited. Early in his work the Italian inventor had discovered the reversibility of the dynamo of his creation, having expressly noted down that if the machine were supplied with energy from an outside source it would run as a motor. The reversibility of the Gramme machine, on the other hand, was not shown until 1873, when two similar dynamos were run as a generator and motor at the Vienna exposition.

Pacinotti resembled Faraday in his taste for research

Antonio Pacinotti

rather than technical exploitation, a characteristic which explains why his epoch-making invention lay dormant for years and was left to others to develop to practical and commercial efficiency. At the time of his death he was professor of technological physics at the University of Pisa and senator of the kingdom of Italy. During the recent Turin International Electrical Congress he received a highly enthusiastic ovation. A history in great detail of his work on the dynamo is given in issues of the *Electrical Engineer* in September, 1895, written by the late Franklin L. Pope. An interesting mention of the work of Pacinotti is contained in an article entitled "The Jubilee of the Dynamo," by Brother Potamian, which appeared in these columns in the issue of July 8, 1911, page 95.

Following is the resolution of election of Dr. Pacinotti to honorary membership in the American Institute of Electrical Engineers:

"*Whereas* the invention of the modern form of continuous-current dynamo, one of the epochal events in the history of electricity, is due to Antonio Pacinotti; and

"*Whereas* the constitution of the American Institute of Electrical Engineers provides that by the unanimous vote of all the members of the board of directors honorary

members may be chosen from among those who have rendered acknowledged eminent services to electrical engineering or its allied sciences; it is

"*Resolved,* That Professor Antonio Pacinotti, of Pisa, Italy, be elected, in recognition of his great achievement, to honorary membership in the American Institute of Electrical Engineers."

Current News and Notes

Captain Scott's Telephone Line.—The narrative of Captain Robert F. Scott's expedition in search of the South Pole, which recently appeared in the *New York Times,* contains an interesting reference to the construction of a 15-mile telephone line. This line was used to connect one of the stations with Hut Point and was found very useful in reporting the movements of parties, pending changes in weather.

* * *

The Tax Burden of Public Utilities.—Three of the public-service companies of Minneapolis—the Minneapolis General Electric Company, the Minneapolis Gas Light Company and the Twin City Rapid Transit Company—together pay more than one-fourth of the total personal property tax in that city, according to a recent statement of the central-station company published in a local newspaper. The Minneapolis General Electric Company alone paid $102,753.40 in taxes into the public coffers last year, which is at the rate of $276 a day.

* * *

General Electric Dinner at Boston.—The annual dinner of the Boston office of the General Electric Company was given at the Hotel Somerset, Boston, on the evening of March 29. Mr. Charles B. Davis, manager of the Boston office, presided, and the principal speaker was Dr. W. R. Whitney, director of the company's research laboratory at Schenectady, N. Y. Dr. Whitney gave an extended résumé of the work of the laboratory, with special reference to the investigations of late years in connection with the tungsten-filament lamp. About three hundred members of the Boston staff and guests were present.

* * *

Rate Reduction in Atlanta.—The Georgia Railway & Light Company and the Georgia Railway & Power Company, of Atlanta, have agreed to reduce their rate for electric lighting from 9 cents to 7 cents per kw-hr. net. The rate for electrical energy used for industrial purposes has been reduced from 5.4 cents to 4.5 cents per kw-hr. net, while the minimum bill for lighting will be $1 a month instead of $2 and the minimum for power 50 cents instead of $1 per hp. The City Council has agreed to accept these rates and withdraw its petition with the state commission for an investigation of electric light and power rates.

* * *

Electric Lights for Horse-Drawn Vehicles.—A coal-wagon teamster was arraigned before a judge of the Municipal Court of Chicago a short time ago on the charge of driving after dark without a light. The defendant declared that the lard oil used in his lamp became solidified owing to the cold weather, so that the lamp was useless. The judge expressed sympathy with the difficulties of teamsters in extremely cold weather and discharged the defendant, with the advice that he request his employer to equip the wagon with electric lamps. It would no doubt be entirely practicable to use a low-voltage battery-operated electric-lighting equipment on horse-drawn vehicles, and the possibility seems worthy of more serious attention than it has received.

* * *

Meeting of Brooklyn Company Section, N. E. L. A.—The Brooklyn Company Section of the National Electric Light Association held its regular monthly meeting April 1. The meeting gave the last opportunity to members engaged in the Seattle competition to gain points through discussion of the papers presented, and nearly all the contestants took part, a five-minute limit being set to individual discussions. The paper of the evening was presented by Mr. W. E. Kampf, of the engineering department, and was entitled "Electric Motors on Brooklyn Edison Service." The varied types of motors on the lines of the company, their applications and general characteristics were treated briefly. The address of the evening was made by Mr. W. H. Blood, Jr., of Stone & Webster, Boston, Mass., who spoke on "The Great Northwest: Its Resources, Beauties and Opportunities." The talk was illustrated with more than 100 lantern slides. As is well known, the Stone & Webster organization operates a number of central-station enterprises in the Pacific Northwest; but Mr. Blood also described some of the developments in other parts of Washington and in Oregon and also showed some travel views of Alaska.

* * *

Convention of National Electrical Contractors' Association.—Arrangements have been completed for the twelfth annual convention of the National Electrical Contractors' Association, at Denver, Col., July 16, 17, 18 and 19, and reservations already made indicate a larger attendance than ever before. Aside from the meetings, the Sons of Jove will be largely represented and a monster rejuvenation will be held. Side trips will be made over the Moffat Road, the Georgetown Loop, Pike's Peak and the Garden of the Gods; there will be automobile trips in and around Denver, and in addition to these a special party is being made up for a visit to the Yellowstone National Park. Private cars from Boston and New York will be attached to the special train from Chicago. A complete itinerary, giving dates, railroad and Pullman fares, together with descriptive matter of the scenic roads around Denver, the trip over the Denver & Rio Grande Railroad to Salt Lake City, where time will be given to visit the Temple and Tabernacle and other points of interest, will be mailed on request. Five days will be spent in the Yellowstone National Park, which includes a 150-mile stage trip, stops at the park hotels and special reservations on the return trip. Mr. V. C. Gilpin, 41-59 Gardiner Avenue, Brooklyn, N. Y., is master of transportation.

* * *

Defeat of New York Water Conservation Bills.—During the closing hours of the last session of the New York Legislature both the Bayne bill and the Patrie bill, relating to the conservation and public development of water-powers throughout the State, met with defeat. The Bayne bill conferred very broad powers on the Conservation Commission, enabling it to acquire and develop water-powers throughout the State and to transmit and distribute such power to municipalities and public-service corporations. This bill had the support of Governor Dix and the Conservation Commission and was passed by the Senate but defeated in the House. The Patrie bill was framed by a legislative committee which had been investigating the subject and of which Speaker Merritt was one of the members. This bill was passed by the House, but met defeat in the Senate. At a number of committee hearings on the Bayne bill a large amount of interesting testimony was introduced. Opposition developed from numerous central-station and power companies in the State, on the general ground that municipal ownership is dangerous and undesirable, and also on the ground that so great an undertaking on the part of the State would very likely become a public burden. The representatives of several municipalities and business organizations appeared in behalf of the bill and urged that New York State could profitably copy the plan now in operation in the Province of Ontario, where the Hydro-Electric Commission is selling Niagara energy to numerous municipalities and villages at a very low rate.

Electricity as a Substitute for Coal.—According to reports from London, one result of the British coal strike has been an enormous increase in the use of electricity for manufacturing printing and other machinery, the increase being over 100 per cent in many cases.

* * *

Cook Tour to the Boston Electric Show.—According to the (London) *Electrician,* Cook & Son have agreed to arrange for a specially conducted party of not less than eight to visit America in connection with the Boston Electric Show, which will be held from Sept. 28 to Oct. 26. The trip would occur from Sept. 14 to Oct. 11, and the party would visit New York, Philadelphia or Schenectady, Niagara, Toronto, the St. Lawrence River, Montreal and Boston.

* * *

Electric Power on the Farm.—Bulletin No. 25 issued by the Engineering Experiment Station at the Iowa State College is entitled "Electric Power on the Farm" and was prepared by Adolph Shane. This bulletin gives a very practical description of the possible applications of electric energy on the farm, describing equipment, wiring and methods of installation. It also contains estimates of the cost of typical installations and gives brief instructions to be followed in daily operation.

* * *

Telegraph Discrimination.—The Postal Telegraph Company has published the statement that the Bell Telephone companies are discriminating in favor of the Western Union Telegraph Company and specifies in particular that when patrons use the Bell service and ask for connection with one of the offices of the Postal Telegraph Company connection is almost invariably made instead with one of the Western Union offices. It is charged that this practice is general throughout the country.

* * *

Floating Exposition for South American Countries.—The American Manufacturers' Export Association is planning to send an ocean liner loaded with exhibits of finished products manufactured in this country into every important port of the West Indies, Central and South America. The project has the indorsement of President Taft and the diplomatic representatives in Washington of the republics of Central and South America. The secretary of the association is Mr. Henry T. Wills, 200 Fifth Avenue, New York.

* * *

Edison Motion Pictures for the Home.—Mr. Thomas A. Edison has developed his kinetoscope in the smaller sizes so that it can now be used in the home and club as well as in public meeting places. The film is greatly reduced in size in that 80 ft. of the new film contains as many pictures as 1000 ft. of the film used in theaters, the rate of exposure of the pictures being the same in the two cases; the scenes pictured and the total time of exposure are also equal. The home kinetoscope is lighted by means of either a Nernst lamp or a miniature arc lamp.

* * *

Magnitude of Telegraphic News.—The *New York Times* recently called attention to the magnitude of its telegraphic news service. During the week ending with March 30 530,000 words were received by telegraph. Of these about 350,000 words were Associated Press matter. The exact total of "special dispatches," as shown by the bills of the telegraph companies, was 181,484 words, divided as to origin into 155,625 words from cities and towns in the United States, and the remainder—25,859 words—foreign news, gathered from all over the world. The foreign service included 24,910 words transmitted by wireless telegraphy.

New York Jovian Dinner.—At the regular semi-monthly luncheon of the New York Sons of Jove held April 3 the guest of honor and speaker for the occasion was Mr. Marshall S. Barnes, president of the National Electrical Contractors' Association. Mr. Barnes chose as his topic "The Contractor's Position in the Electrical Trade," and in the course of his address, which was listened to with interest, told of the formation and success of the National Electrical Contractors' Association, the dominating note of which is co-operation. The speaker attributed the present excellent condition of the contractors' association to that influence. The committee which was appointed some weeks ago to investigate the advisability of the Jovian order indorsing the people's electrical page reported that after mature investigation it had come to the conclusion that such action at the present time would not be prudent. The committee suggested that before the Jovian order indorse the proposition the various electrical interests, jobbers, contractors, manufacturers, etc., be consulted and their opinion of the ultimate success of such a scheme be obtained. The committee expressed its willingness to pursue the matter further if desired.

* * *

Electric Club Discusses Chicago Street Lighting.—Mr. H. Schaedlich, of the Department of Electricity of the city of Chicago, discussed the new street lighting of that city at a meeting of the Electric Club of Chicago on March 28. This lighting is being carried out by the Sanitary District under contract with the city and has been the subject of several articles in these columns. Mr. George C. Keech referred to the disinterested effort of the Chicago Section of the Illuminating Engineering Society to secure a 30-ft. suspension for the powerful 10-amp flaming arc lamps to be used, rather than the 20-ft. suspension which the city authorities seem to favor for reasons having to do with first cost and operating practice. Mr. Schaedlich said that the arc-lamp trimmers employed by the city object to climbing to a greater height than 20 ft. to renew the carbons and clean a street lamp. He also seemed to think that there was objection to the practice of lowering the lamps for trimming from the greater height and also to the use of tower wagons in a large installation. The new lamps will be spaced about 300 ft. apart on residence streets and about 250 ft. apart on business streets. Overhead construction is used largely, and in that case the lamps are all on one side of the street. Where underground construction is used, the lamps are staggered on both sides of the street. Mr. Harold B. Barnes, of Denver, an electrical engineer and a member of the Colorado Electric Club, described the various methods of street lighting in use in Denver, the "City of Lights." In that city the use of magnetite arcs has been very satisfactory in residence districts, although ordinary inclosed alternating-current arc lamps are used on the business streets, suspended from street-railway poles at a height of 16 ft., while series tungsten lamps are used in parks and boulevards.

* * *

SOCIETY MEETINGS.

Pittsburgh Jovians.—It is expected that from 250 to 300 persons will be initiated by the Sons of Jove at a rejuvenation to be held in the Fort Pitt Hotel, Pittsburgh, on April 13. The plans for the function are being made by Statesman W. P. Shaler and Reigning Jupiter Robert L. Jaynes.

* * *

Western Society of Engineers.—At the regular meeting of the Western Society of Engineers, held on April 1, a paper on "Arbitration" was presented by Mr. Onward Bates. The paper by Mr. Bates is of interest to engineers and others who may have occasion to act as arbitrators in the settlement of disputes.

TURBINE-DRIVEN STATION AT ATLANTIC CITY, N. J.

New Plant of the Atlantic City Electric Company for Supplying Electricity and Hot-Water Heat.

Steam Extracted for Heating Purposes from Second and Third Stages of Turbines Operating Condensing—Facilities for Handling and Storing Coal—Arc Machines and Direct-Current Generators Driven by Synchronous Motors—Bus Structure Work—Station One of the Attractions of the City.

THE Atlantic City Electric Company, which is controlled by the American Gas & Electric Company, has erected and is now operating in the outskirts of Atlantic City, N. J., at Missouri Avenue and Beach Thoroughfare, what is purported to be one of the best and most economical stations of its size in the country. Electric-light men who have attended any of the numerous conventions held at Atlantic City will remember the old 125-cycle, single-phase station, adjoining the tracks of the Pennsylvania Railroad, which formerly supplied all of the electrical energy for the city. This building housed 1400 kw in direct-current apparatus, 2690 kw in alternating-current apparatus and seven 125-light Brush arc machines. The direct-current apparatus comprised three Fort Wayne three-wire machines, one rated at 600 kw and driven by a Wetherill engine and the other two rated at 400 kw and driven by cross-compound Allis-Chalmers engines. There were nine 125-cycle, single-phase alternators of General Electric, Stanley and Westinghouse make feeding the network of overhead 2300-volt lines.

The boiler equipment comprised 2820 hp in Edgemoor water-tube boilers fitted with Jones under-feed stokers, 1200 hp in double-deck return-tubular boilers and 1400 hp in single-deck return-tubular boilers. The boilers fitted with stokers were operated under forced draft. The station was typical of the older class of plant with additions made from time to time as the load increased. Having a hot-water heating load for about eight months of the year, high efficiency in the electric generating units was not desired or sought. The load, however, reached a point where more equipment was necessary, and since extensions on the old site were not possible owing to lack of space and since also the 125-cycle system had become obsolete, it was determined to erect a new station which would be modern in every respect and which would also be an added attraction to the city.

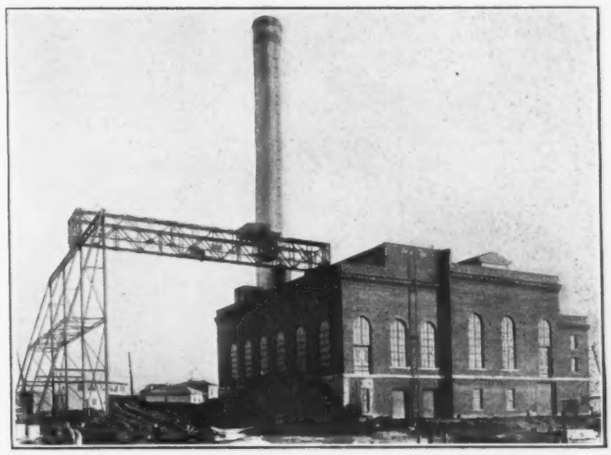


Fig. 2—Exterior of Power Station.

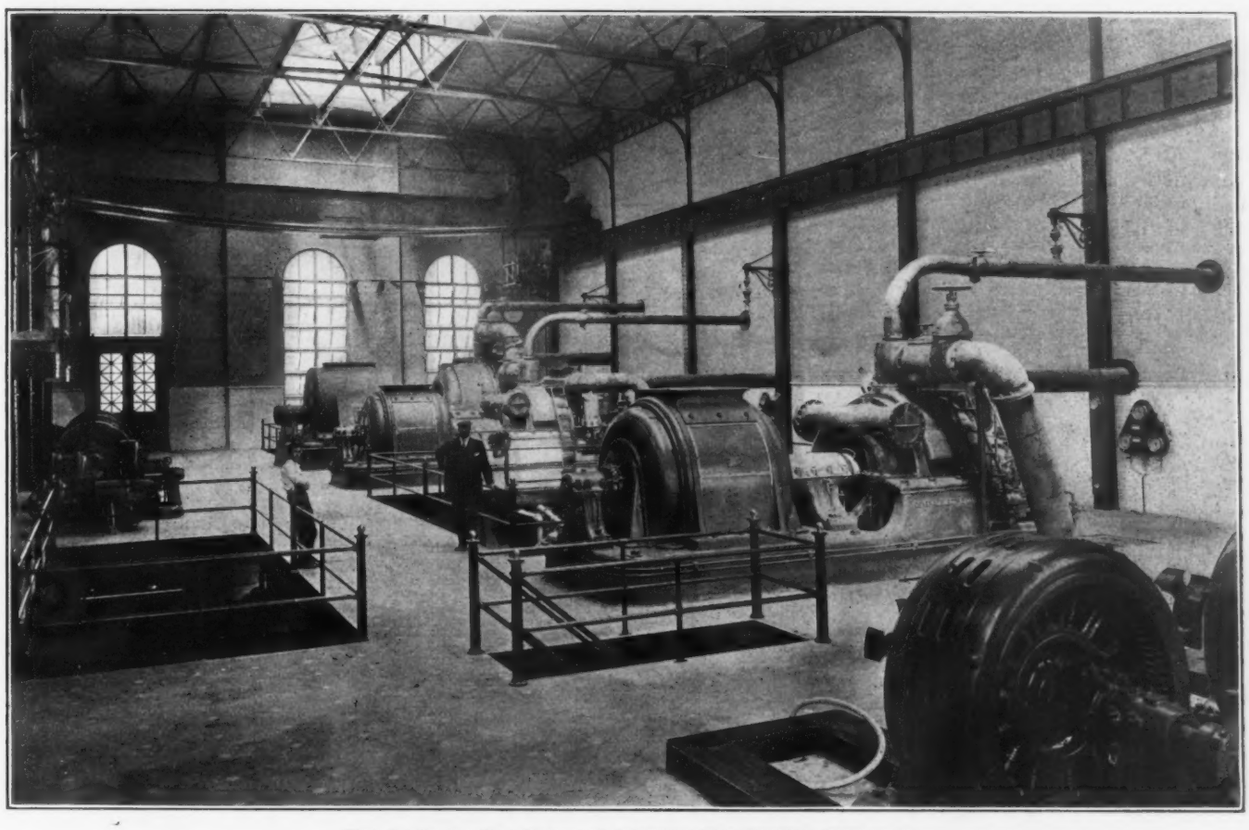


Fig. 1—Generating Room of Atlantic City Electric Company.

The new generating station, views of which are given herewith, was designed to be operated with a minimum working force and also to turn out a kilowatt-hour of energy as cheaply as possible. The site of the station is on a

meadow formerly washed by every high tide. After being covered with 2.5 ft. of sand, 1509 30-ft. pine piles were driven to refusal on an average of 3-ft. centers, upon which the footing of the building was placed and brought up level with the basement floor. The tops of the piles were cut off at low-water mark so that they would be covered by water at all times. Extending through the turbine-room basement and resting on the piles is a concrete mat 7 ft. 6 in. thick on which the foundations of the machines are set. The turbines are set 16 ft. above the floor level and the condenser intake tunnel leading from the Thoroughfare, the body of water cutting off Atlantic City from the mainland, is located 12 ft. below mean low-water mark and in the mass of concrete extending from the bottom of the tunnel to the turbine foundations as shown in the engraving. The intake and discharge tunnels are each 4 ft. high, the former being located beneath the latter, and the maximum lift to the basement is 10 ft. at low water and 6 ft. at high tide. The intake, which extends 130 ft. from the station, is protected by a crib. The latter is built of reinforced concrete with beams for tying the walls together and bracing the structures. Cast-iron guides are provided for the screens and grilles, and two 42-in. sluicegates are fitted in the front wall of the intake crib and two sets of ½-in. mesh copper screens serve to keep out fish and foreign matter. Beyond the crib and as an added protection is a forebay formed by creosoted piles extending 20 ft. into the Thoroughfare.

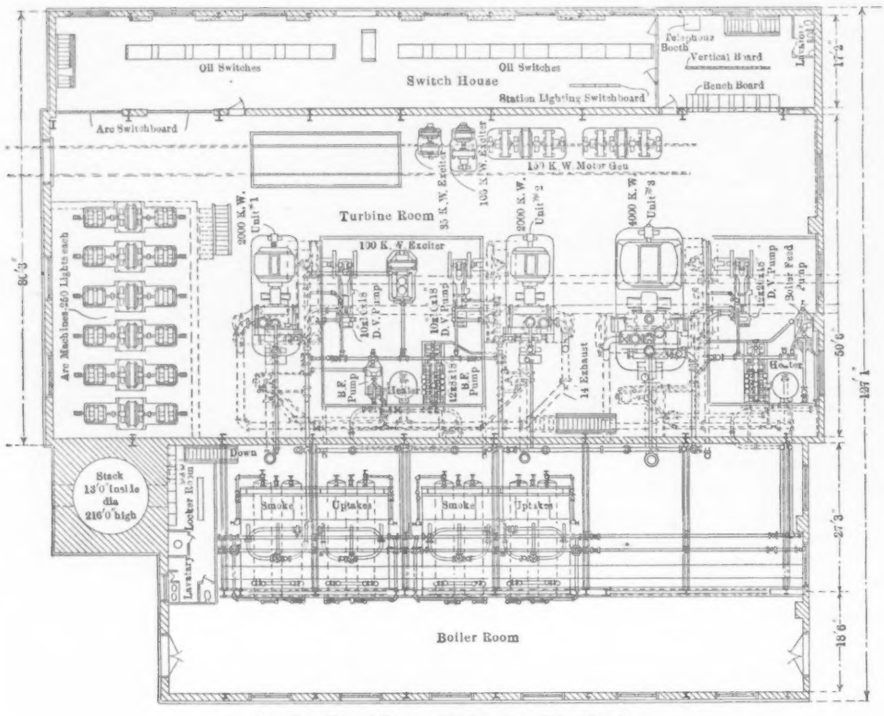


Fig. 3—Plan View of Atlantic City Station.

Coal is brought to the station over a siding from the Pennsylvania Railroad or may be brought to the wharf in front of the station by barge, and provision is made for storing 15,000 tons under the craneway outside the station. The crane, which has a span of 100 ft., is equipped with a 2-yd. grab bucket and a traveling coal crusher designed to pass 75 tons an hour through 1½-in. mesh. The crane itself can handle 40 tons of coal an hour from the cars to the bunkers and 60 tons an hour from the cars to the storage pile.

The crane is equipped with four motors, one for bridge travel, one for trolley travel, and the operations of raising, lowering, opening and closing are effected by two motors on two separate drums fitted with friction clutches. The auxiliary hoist motor closes the bucket, and the operator rides with the trolley and controls all of the movements from his cage. The motors are of the 250-volt interpole, direct-current type, the main hoist motor being rated at 50 hp, the auxiliary hoist at 30 hp, the bridge travel at 30 hp and the trolley travel at 5 hp. The speed of the main hoist fully loaded is 120 ft. a minute, that of the trolley 120 ft. a minute and that of the crane itself 300 ft. a minute.

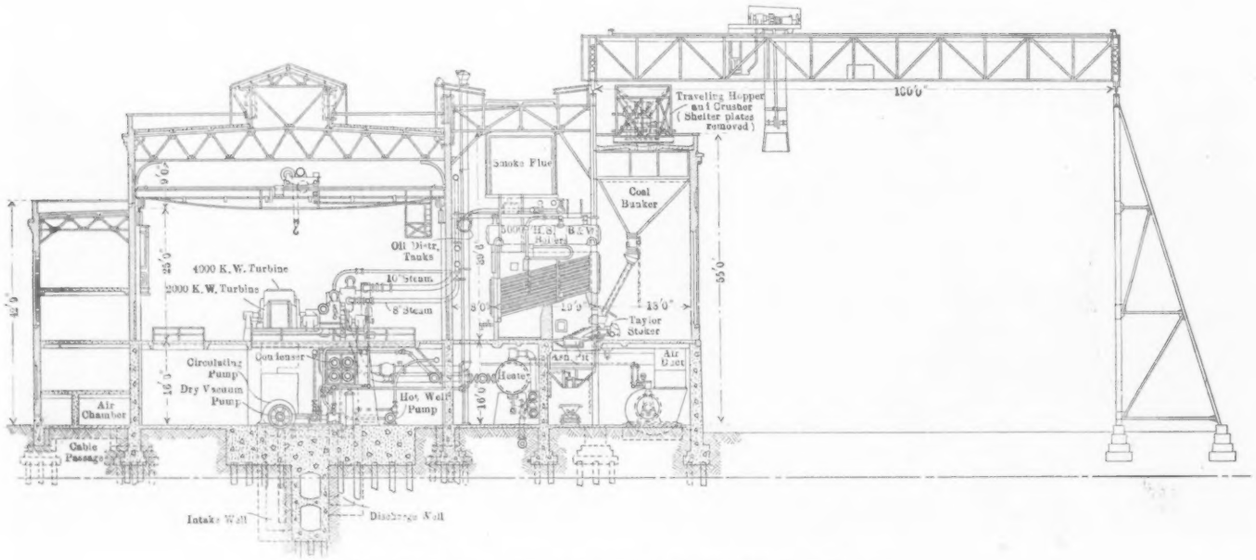


Fig. 4—Cross-Sectional Elevation of Atlantic City Station.

The coal crusher is mounted on a truck arranged to run on a track over the roof of the boiler-room. It is equipped

with a steel plate hopper on top of the crusher capable of holding two grab-buckets full. The crusher is arranged so that when it is handling fine coal the latter will pass through the crusher without requiring the running of the crusher motor. The crusher motor can be cut out from the gears and used to run the truck with the crusher along the track over the bunkers in either direction. The motor is operated from trolley wires attached to the runway girder.

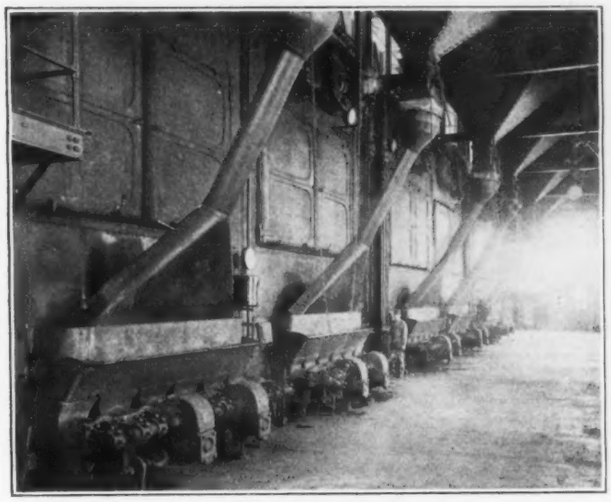


Fig. 5—General View of Boiler-Room.

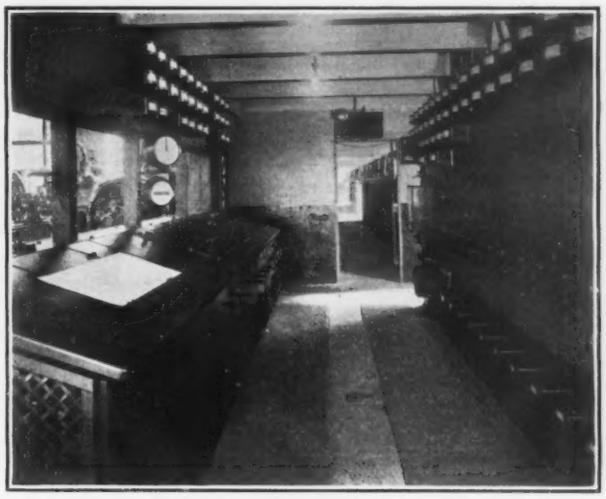


Fig. 7—Remote-Control Switchboard.

Provision is made in the boiler-room for six B. & W. water-tube boilers fitted with single-loop superheaters within the setting and designed for operation at 225 lb. pressure. The furnaces are fitted with six-retort Taylor gravity stokers, coal for which is chuted from the bunkers overhead, as indicated in Fig. 5. Feed water for the boilers is pumped by two 3-in., four-stage horizontal, centrifugal pumps, each direct-connected to a 54-hp Curtis turbine.

The main generating equipment comprises two 2000-kw and one 4000-kw, 2300-volt, 60-cycle, three-phase Curtis turbo-generator. There is a 6-in. outlet on each of the two boilers for the 2000-kw units, feeding into an 8-in. header passing through the division wall to the turbine throttle. A 10-in. header supplies steam to the 4000-kw unit. The steam headers are connected with loops, the loops between the first and second units being of 6-in. pipe, and that between the second and third units of 8-in. pipe, a valve being fitted to each header. There is a 16-in. free exhaust from the condenser of the 2000-kw units and a 24-in. free exhaust from the 4000-kw unit. Each of the 2000-kw units has a 16-in. outlet from the second stage of the turbine, and the 4000-kw unit has an 18-in. outlet. A 14-in. connection runs from each outlet to 14-in. exhaust headers. The second stage connection from each unit has an 8-in. back-pressure valve to serve as a relief, a 14-in. gate and a 14-in. automatic reverse-current valve. The connections to the headers for the hot-water-supply system have 14-in. gate valves and 14-in. oil separators.

The auxiliary equipment for the 2000-kw units comprises an Alberger surface condenser having 6000 sq. ft. of condensing surface, a dry-vacuum pump, a 16-in. volute circulating pump, a 3-in. turbine-driven hot-well pump and a priming pump. The largest unit has an Alberger surface condenser with 10,000 sq. ft. of condensing surface, a dry-vacuum pump, a 20-in. volute circulating pump, a 4-in. turbine-driven hot-well pump and a priming pump. In addition to this auxiliary equipment there are two horizontal duplex feed pumps, two vertical Platt Iron Works open feed-water heaters, two duplex horizontal hot-water circulating pumps, two hot-water heaters, two stokers and fan engines, one 100-kw engine-driven exciter set, two deep-well pumps, one automatic pump and receiver, two small oil pumps, one oil filter, an air compressor and a small oil pump on each turbine. The auxiliary equipment is located in the basement and receives abundant light through a well in the turbine-room floor.

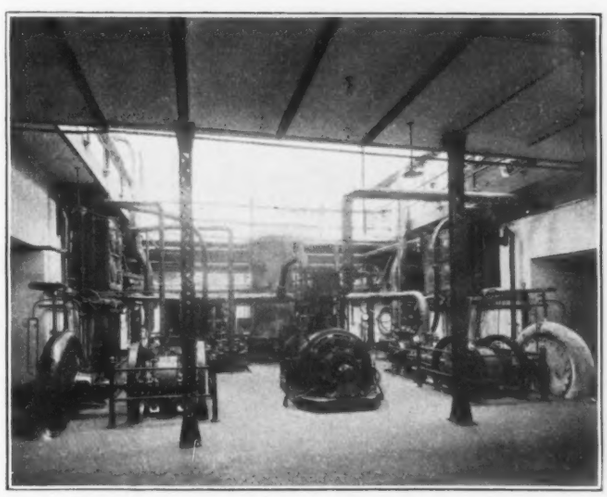


Fig. 6—Auxiliary Apparatus in Basement.

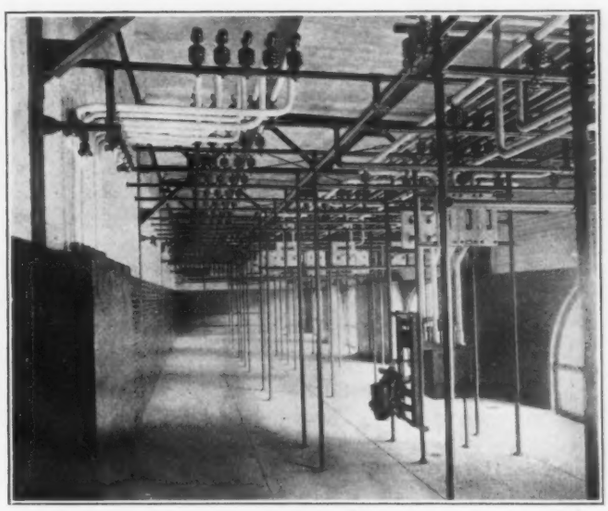


Fig. 8—Typical Bus Structure Arrangement.

The feed pumps and heaters are arranged in sets; that is, there is a set of two pumps and one heater for units 1 and 2, and a similar set for No. 3, which will also suffice for unit No. 4 when that is installed. For supplying the hot-water heating load there is a 14-in. main passing underground. The hot-water heating system covers 1½ miles of territory extending from the Boardwalk to Baltic Avenue and from New Jersey Avenue to Arkansas Avenue.

The stack is 13 ft. inside diameter and 216 ft. high. It is built of concrete and has a brick base. As already indicated, the turbines are arranged for the extraction of steam from the second and third stages, for which purpose an 18-in. opening is provided in each of the stages. The second stage has hand-operated valves, by means of which the nozzle opening to the third stage may be controlled, but no such arrangement is provided in the third stage.

The auxiliary electrical apparatus for supplying excitation and direct current comprises, in addition to the 100-kw marine engine set located in the basement, a 100-kw induction-motor-driven exciter set, a 35-kw induction-motor exciter set for the synchronous motors, two three-unit, 300-kw sets, each comprising a 325-kw synchronous motor direct-connected to two 150 kw, 275-volt direct-current generators. The latter are designed to operate as shunt-wound machines at from 230 to 275 volts at full and overload currents, and are fitted with series windings by means of which the emf may be raised 25 volts, so as to give 300 volts on each generator, or 600 volts when operated in series. These sets are started from the alternating-current end only and will not be operated reversed. There are also four 200-hp synchronous motors driving eight arc machines through flexible couplings. Provision is made for two more sets. In the basement a 55-cell, 110-volt Gould battery is installed as a reserve for the control system.

The switchboard is designed to control at present one 4000-kw unit, two 2000-kw units, two 100-kw exciters, two three-unit motor-generator sets, six 1500-kw, three-phase feeders, two 500-kw, 250-500-volt, three-wire feeders and three 2300-volt, three-phase synchronous motors. The operator's room is located at one end of the station, as indicated in Fig. 3. All of the switches are of the remote-control type, with the exception of those used on the arc-lighting system, the arc-lamp circuits being controlled from the switchboard on the main turbine-room floor.

As shown in the cross-section elevation, three floors are provided in the switch-house. The bus chambers are located in the first section and the oil switches in the second section; the upper gallery is devoted to regulators, arresters, switches and transfer buses. The conductors are brought to the switch-house in conduit, barriers being arranged so that no two conductors are in the same runway or cell. The buses are of flat copper, and the connections are made with copper tube. The work in the switch-house was performed by the company and reflects great credit for the neatness with which it is arranged and executed. A sample of the work is shown in Fig. 8.

There is a signal system arranged between the control board and each turbine, and there is in addition an annunciator drop-signal system indicating when the relays on the breakers and oil switches open. As indicated in the engraving, the turbine-room is well lighted from a wired-glass monitor extending over the entire room. There is a monitor provided over the front and back of the boilers also. Much consideration has been given to the finish of the station. The floor of the turbine-room and of the room containing the auxiliaries is finished in red tile relieved by yellow tile at 18-in. centers. The wainscot is of white glass brick and the wall above is finished in a light drab color. The steel work is painted black, as is also the machinery. A visitors' gallery overlooks the generator room. At the present time the station equipment is undergoing complete test, the results of which we hope to be able to present in a future issue.

THE BOSTON ELECTRIC-VEHICLE CAMPAIGN.

Enterprising Activity of the Boston Edison Company in Establishing a Co-operative Program for Electric-Vehicle Development in Eastern New England.

THE Boston electric-vehicle campaign is one of the most significant developments of the past decade in the central-station field. From its inception in February, 1911, it has attracted national attention; it has received extended space in the periodical and daily press and is frequently the subject of comment in electrical circles limited by no national boundaries. It marks the coming of better days for New England highway transportation, illustrates the power of co-operation against a conservatism born of early failures, and is demonstrating week by week that the electric vehicle has left its experimental stage far behind and taken its permanent place in the flexible, reliable and economical carriage of persons and merchandise upon the public roadways.

Until the campaign has been viewed as a whole the amount of work accomplished cannot easily be realized. Nearly every week since the movement began has witnessed some striking step forward, and both originality and business acumen have had full play in its development. At the close of the first year's efforts it is fitting to sum up the more striking achievements of the campaign which has without question made Boston the focus of the electric-vehicle industry. Upward of $150,000 has been expended by the co-operating interests in charge of the work. An enormous amount of personal effort and loyalty has been devoted to the cause, often in the face of considerable outside skepticism. The results cannot fully be measured in so short a time, but it is significant that to-day a score of electric trucks and pleasure vehicles are represented by agencies in Boston, compared with seven a year ago; that during the past two weeks a new electric-vehicle registration was made at the office of the Massachusetts Highway Commission every two hours of each business day, and that the total number of commercial machines and pleasure outfits registered in the past year increased 56 per cent, mainly as a result of the vigorous exploitation and careful marketing of electric service which began with the famous telegram of President C. L. Edgar, of the Edison Electric Illuminating Company of Boston, to all the prominent electric-vehicle and accessory manufacturers of the country on the night of Feb. 25, 1911, announcing the starting by the company of a hundred-thousand-dollar campaign of education and purchase of electric vehicles in the 600 square miles of its territory.

In response to President Edgar's telegram, 100 representatives of electric-vehicle interests met at the Hotel Thorndike, Boston, on March 3, 1911, and the co-operative movement was fully launched. Then followed the establishment by the company of a special vehicle research division of the electrical engineering department of the Massachusetts Institute of Technology, the object being to secure a complete scientific study of transportation costs and data upon which much of the future work will be based. The scope of this investigation and the methods of its organization and work are described elsewhere in this issue.

On April 3, 1911, the company gave an informal dinner to electric-vehicle and accessory representatives in its territory, and the plans of the campaign were discussed in considerable detail. On April 17 the New England Section of the Electric Vehicle Association of America was organized, and on April 20 the first of the weekly "electric-vehicle luncheons" was established, those present being organized on April 26 under the name of the Electric Vehicle Club of Boston. With the exception of a few weeks' interim during the summer these gatherings have been held regularly on Wednesdays at the Edison Building, Boston, and have been attended by electric-vehicle dealers and manufacturers, by Boston Edison officials, and by central-station men, jour-

nalists and others interested in the storage-battery automobile and its progress in the New England field.

A striking feature of the campaign from its inception has been the extensive use of newspaper advertising and the publicity by means of reading matter which have been constantly on the program. Full-page displays have been carried in the Boston papers, metropolitan and suburban, and press notices of the greatest value and interest have been published. Numerous lectures have been given by the president

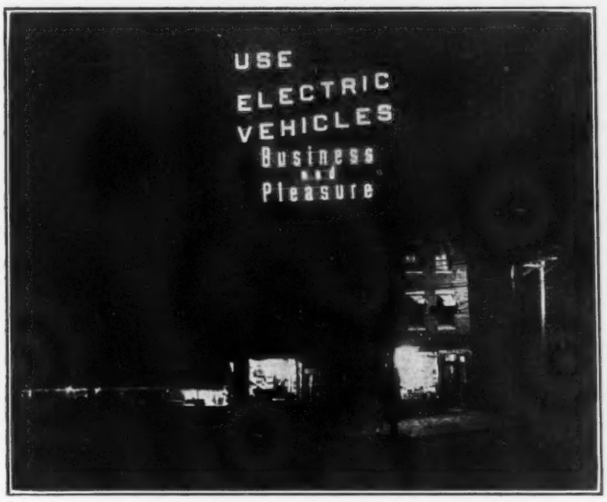


Fig. 1—Typical Electric-Vehicle Sign.

of the club before business men's associations, colleges, technical schools, church and trade organizations, illustrating the peculiar fitness of the electric vehicle in its field, and in all cases these talks have been illustrated by a large collection of lantern slides showing the latest applications in both business and pleasure service. A considerable number of attractive booklets and folders have been mailed to prospective customers in the name of the Electric Vehicle Club of Boston, and the Edison company has constantly given the weight of its sanction and the resources of its treasury to the propaganda, the prestige of so great an organization for the efficient production and distribution of electricity being a convincing factor in the public mind. The burdens of the advertising work have been shared by the Edison company and the representatives of manufacturers of electric vehicles and accessories, and the electric-vehicle pages run in the newspapers, as well as the other forms of publicity employed, have stimulated inquiries and directed sales all along the lines of the company, besides resulting in the creation of a great amount of interest outside the Boston territory.

Space will permit only a summary of some of the most telling shots fired in the campaign, most of these marking distinct forward steps in the work as a whole. The Edison company early offered the free use of its advertising space in fifty suburban newspapers, with an aggregate circulation of nearly 70,000. Free electrical energy is provided to agents and garage owners for the operation of electric signs advertising electric vehicles, charging-station locations and vehicle charging for demonstration service. Much of the reading space on the company's fixed and talking electric signs in the city and suburbs of Boston has been devoted without cost to the dealers to the advertisement of electric vehicles. On Memorial Day, 1911, over sixty electric machines were paraded in the Back Bay district of Boston in contrast to the workhorse parade which has been a feature of Boston life for many years, and through the courtesy of Mr. Thomas A. Edison, moving pictures were taken of this display. The Electric Vehicle Club has given attention to the provision of parking spaces in the congested portions of the city of Boston, securing substantial concessions in relation to the Common and Public Garden frontages and borders, and has taken through its president an active interest in proposed legislation at the sessions of the General Court. Confidential lists of prospective customers have been assembled by the secretary of the club for the use of members directly concerned, the Edison company's officers taking the initiative in many instances in securing interviews with sales representatives and furthering the establishment of patronage. At the Boston City Club in December, 1911, a city and state banquet was given under the auspices of the organization, and many public officials were brought into immediate contact with the possibilities of electric-vehicle service.

Through the action of the company charging sets have been supplied to electric-vehicle purchasers on the most favorable terms, and credits have been given for temporary installations rented prior to the purchase of the equipment. Illuminated billboards have been placed in service in the park districts at the expense of the company, advertising electric pleasure vehicles and trucks, and space has been given free to dealers in the company's show window at its main offices for the display of vehicle equipment and photographs of the latest applications. The House of Edison Light, illustrating numerous domestic applications of electricity, has been transported from one suburb of Boston to another by electric trucks, and at the present location in Newton Center a regular weekly meeting of the club was held last fall, all the members and guests in attendance being carried to the spot in electric vehicles. Similarly, transportation to a meeting of the club with the New England Section of the Electric Vehicle Association of America was accomplished by electric machines at an evening meeting in the General Electric Company's Lynn works, where a supper and technical discussion of electric vehicle motor and control progress were the features of interest, addresses also being given by prominent electrical engineers upon the broader aspects of the electric-vehicle situation. Arrangements have recently been completed by the Edison company for a free monthly inspection of electric vehicles at the Atlantic Avenue garage, all owners being invited to make this available in the interests of securing improved service and still greater reliability of operation. A copy of the report of every meeting of the Electric Vehicle Club is sent to the Accumulator-Fabrik Aktiengesellschaft, of Berlin,

Fig. 2—Boston Electric-Vehicle Luncheon.

Germany, and much interest has been expressed by that organization in the work at Boston.

Pennants advertising electric vehicles have been designed under the auspices of the club, and a composite pleasure-car seal and a similar commercial-car seal have been prepared for use in official correspondence. Through the work of the club officers all railroad and steamship terminals in Boston have granted free use of their facilities to electric vehicles, and the fire-insurance interests have had their attention

called to the nominal risk of this type of equipment, with the hope that certain reductions in rates ultimately may be forthcoming. It was lately announced that the farm exhibit of the Edison company, showing motor and other electric applications in agricultural service, will be transported about the territory by electric machines during the coming open season. At one of the meetings of the electric-vehicle interests it was announced that if the 25,000 tons of freight handled daily in Boston by horse, steam and gasoline traction were handled by electric vehicles the estimated saving would be $1,250,000 per year. During the heated season of 1911, when the vitality of both horses and men frequently broke under the strain of the weather, a special effort was made to emphasize the value of electric trucks and delivery wagons. During the slippery weather of the past winter the club has had a part in the relief of street congestion and the improvement of traffic conditions resulting from the falling of horses on grades. A talking electric-vehicle sign costing $5,000 has lately been authorized by the Edison company.

The electric vehicle was featured at the March 15 meeting of the Luncheon Club branch of the New England Section, National Electric Light Association, in an address by Mr. W. P. Kennedy, of New York, consulting engineer, upon the "Availability and Adaptability of Electric Vehicles for New England," and at a banquet given in honor of the conclusion of the first year's campaign, at the Hotel Thorndike, Boston, a few days before, Mr. P. D. Wagoner, president of the General Vehicle Company, Long Island City, N. Y., delivered the principal address, viewing the vehicle situation, as did Mr. Kennedy, from a national standpoint and giving many figures of encouragement in connection with the development of the industry. Boston now has more electric-vehicle manufacturers represented within its limits than New York, Chicago or Philadelphia. At the Boston, 1912, Electric Show the most complete display of electric pleasure and commercial vehicles ever assembled will be massed under the same roof, and in the general shows of commercial and pleasure cars held at Boston during the early and middle part of March of this year the electric machines attracted widespread attention even in the midst of the display of gasoline cars. The Electric Vehicle Association of America has been invited to hold its annual convention at Mechanics' Building, Boston, during the 1912 Electric Show next October, and it is planned to make a special feature of the subject of electric-vehicle development at Boston as an adjunct to the forthcoming convention of the American Institute of Electrical Engineers.

The officers of the Boston Electric Vehicle Club are: President, Day Baker; vice-president, E. S. Mansfield; secretary and treasurer, Leavitt L. Edgar; executive committee, the officers and Messrs. H. F. Thomson and F. N. Phelps and Colonel E. W. M. Bailey; finance committee, Messrs. W. H. Blood, Jr., J. S. Codman and Frank J. Stone; advertising and publicity committee, Messrs. Bowman, D. C. Tiffany, Day Baker and H. S. Knowlton; rates and charging sets committee, Messrs. P. E. Whiting, Carpenter and A. F. Neale; membership committee, Messrs. J. A. White, Neale and G. W. Holden; Electric Show committee, Messrs. J. W. Emery, F. N. Phelps and Dearborn Bailey; arbitration and neutrality committee, Messrs. Mansfield, Stone, Holden, Day Baker and Carpenter; electric-vehicle headquarters committee, Messrs. Codman, White and Emery; docks and parking facilities committee, Messrs. Tiffany, Rommelfanger and Turner; educational committee, Messrs. W. E. Eldredge, L. A. Tirrell and C. F. Smith, and "prospects" committee, Messrs. F. J. Stone, Brooks Faxon and H. L. Converse. Messrs. W. H. Atkins, W. H. Francis, L. D. Gibbs and L. R. Wallis, of the Boston Edison company, have taken an active part in the work of the club in the past year, and Mr Converse D. Marsh, of New York, has had direct charge of the publicity campaign in a consulting capacity.

ELECTRIC-VEHICLE RESEARCH AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Special Department Established to Determine Comparative Costs of Operating Electric, Gasoline and Horse Vehicles.

ONE of the most important developments in connection with the electric-vehicle campaign at Boston is the establishment of a special research division of the electrical engineering department of the Massachusetts Institute of Technology, with the object of making a scientific investigation of the costs and methods of merchandise transportation in large cities by electric, gasoline and horse-drawn trucks. The inception of this work, its authorization and maintenance are due to the Edison Electric Illuminating Company of Boston, which made a special appropriation in May, 1911, on behalf of an impartial investigation of the economics of vehicle service. Dr. Harold Pender has had general supervision of the work, which is being carried out by Mr. H. F. Thomson, of the instructing staff.

A striking feature of the research undertaken is the freedom of investigation accorded the staff, the object of the Edison company being to obtain accurate cost data irrespective of the type of transportation making the best showing in particular cases. The company is, of course, of the opinion that the electric vehicle offers the best solution of the urban and suburban merchandise highway transportation problem, but it recognized the importance of assembling material bearing upon costs and service along entirely impartial lines, so that the limitations of every type of transportation studied might be disclosed. The investigation has not yet been sufficiently extensive to warrant the drawing of any sweeping conclusions, and the data secured are not at present available for publication, although in the near future it is probable that they will be printed The general lines of attack upon the problem of economic transportation by motor vehicles and by horses as followed at the Institute are, however, of much interest, and indicate in a marked degree the close relationship existing between industrial service and scientific investigation. The value of such work in the advancement of electric-vehicle transportation is certain to be felt over a wide area, since it will go far to supply the central-station interests with reliable data from which general conclusions may be drawn and with which comparisons may be made in specific cases encountered elsewhere.

In order to obtain a broad survey of the motor-truck situation, Mr. Thomson began the investigation by a trip to seventeen cities in the eastern part of the country, traveling within the area bounded by Boston, Chicago, St. Louis, Pittsburgh and Washington. In each city certain houses using gasoline or electric trucks were interviewed, with the object of obtaining from these firms data on the amount of work done by the trucks and the cost of their operation, as well as similar information on horses where the latter were used. In most cases where serious efforts were being made to determine the cost of wagon operation data were either given or promised the Institute, the owners of the equipments in all cases being informed that the figures submitted by specific organizations would not be used in connection with the names of the latter.

For the purpose of tabulating the information contained in the reports from the various users into comparable form, standard report blanks for horse, gasoline and electric vehicles have been prepared. It is planned to forward these blanks, together with copies of the reports to be made on the subject from time to time, to any firm or individual having information available for the Institute. It is intended to design a complete system of garage records in the near future. So far as the forms have been developed they

comprise features drawn from a large number of present systems, and combine the points on which information is desired with headings under which the various costs can conveniently be grouped.

Taking up some of the principal points covered on the report blanks, a "Class of Service" item refers to the trucks this item includes the renewal of engine parts. The cost of "Garage" when a private garage is operated includes the charges for the building and its equipment as well as the wages of foremen and attendants. "Amortization" is taken as a fixed annual charge intended to cover the replacement of a machine by a fund at the end of its useful

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

VEHICLE RESEARCH

REPORT OF ELECTRIC TRUCK OPERATION

Company
City
Business
Class of service
Period covered by data mo.
Number of trucks for which following data are average
Tires:
Front
Rear
Remarks

Truck:
Manufacturer
Rating
Weight
Cost
Age
Company's number
Style of body
Battery:
No. of cells
No. and type of plates

PERFORMANCE PER TRUCK.

	Average per year	Average per month	Average per day used	Average per mile
Miles run				
Kw-hr. input at { battery / switchboard				
Work days used				
Work days out of commission				
Number of trips				
Number of stops				
Number of pieces delivered				
Weight of loads				

EXPENSE PER TRUCK.

	Average per year	Average per month	Average per day used	Average per mile
Operating costs				
Running repairs				
Lubricants				
Electricity at cents per kw-hr.				
Garage (rent, attendance)				
Sundries				
Driver and helper				
Total				
Maintenance costs				
Battery renewals				
Tire renewals				
Electrical and mechanical parts renewed				
Painting and body work				
Total				
Fixed charges				
Amortization at % on				
Administration				
Interest at %				
Insurance (all)				
Taxes				
Total				
Grand total expense				
Cost per				

Fig. 1—Blank Form for Tabulating Information.

assignment of work, such as city pick-up, suburban delivery, meter installation, etc. The "Period Covered by Data" shows the number of months over which the figures given in the report have been collected, as data covering several years naturally have greater weight than those of a few months only. The item "Number of Trucks" is introduced to cover the case where the records of several machines of a given class are combined and averaged. The item of "Tires" is intended to include both size and type, as solid, pneumatic or cushion. Under "Performance per Truck" the energy input at either battery terminals or at the line side of the switchboard is indicated, as there has been found a lack of uniformity in the location of integrating wattmeters. For the item "Work Days Out of Commission" is given the number of days, exclusive of Sundays and holidays, when the car was not in a condition to be used. The items of "Trips," "Stops," "Pieces" and life. "Administration" covers that portion chargeable to the truck of the office expense in connection with the transportation department. "Interest," "Insurance" and "Taxes" cover the proportionate part of such expenses assignable to the equipment covered in the report.

In the tabulation of data four columns are designed for the performance and expense items in order that either the year, month, day used or mile may serve as a unit. These four units are suggested for the reason that neither a time nor a distance basis is regarded as fair for all classes of service. Annual and mileage figures are more generally used as a means of comparison at present, but monthly and daily figures have been advocated in some cases. In reporting a truck the research division does not expect that all four columns will be filled, as any one column will give information from which the other three may be computed. The latest forms used include space for the insertion of

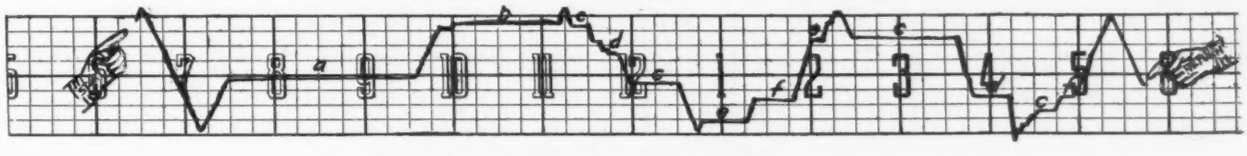


Fig. 2—Tape Record, Showing Performance of a Two-Horse Wagon.

"Loads" can be filled in only for the cases where these are units of the service. The item "Running Repairs" refers to the cost of the minor repairs which must be made from day to day, and the item "Overhaul" refers to the periodical (commonly yearly) overhauling when worn parts are replaced in order to restore the mechanism as nearly as possible to its original condition. In the case of gasoline operating and road conditions bearing upon the cost of service.

The investigation has disclosed a great lack of specific information on the performance of vehicles in various services, and in many cases it has been found that, whether the unit of work consists of packages, cases or tons, little record is kept of the number of these units carried by a

particular wagon in a given time. Little or no attention has been paid to the manner in which the work is performed, including such items as speeds, stops, idle time, etc. One branch of the investigation is therefore the compiling of such information. The medium for obtaining the data is the installation on the wagons of recorders which furnish tapes indicating the stops and movements of each vehicle. The service of the Boston Delivery Supervision Company, a licensee of the International Speed Register Company of New York, is used to maintain the registers and collect the tapes daily. Arrangements have been made with six representative Boston firms for the installation of registers on certain wagons, and nine companies are now furnishing tape records daily. The services cover city pick-up, furniture moving, freight haulage, general freight handling, baggage transfer, coal delivery, parcel delivery, bottled goods delivery, miscellaneous hauling and central-station installation, maintenance and transportation service. About seventy tapes per day will shortly be regularly received by the research division. The vehicles range from one-horse to three-horse wagons, 700-lb. to 10,000-lb. electric trucks and 1000-lb. to 6000-lb. gasoline trucks. The tapes are collected by the Supervision company at night and are received by the various owners in the morning. Any information which they desire to record is noted, and the tapes are then forwarded in special envelopes to the Institute. In most instances there is also forwarded a specific report which includes the amount of work done by the vehicle throughout the day, so that the tape and report together give a complete account of the vehicle's performance. The tapes are then analyzed and either filed for reference or returned to the owner of the wagon. Reports are also obtained on the expense of operating the several vehicles, in order that the cost per unit of work done may be computed.

A representative tape record is reproduced, showing a recent day's performance of a two-horse wagon. The letters of the tape indicate the geographical points visited by the wagon. The tape records are essentially distance-time curves, the heavy line recording the movements of the vehicle. The width of the tape is equivalent to 2 miles of travel. Where the line is inclined it indicates that the wagon is moving, and its slope is proportional to the speed, horizontal indications being given when the vehicle is standing still. A special instrument is used by the research division to facilitate reading directly the vehicle speeds as given from the slopes of the cross-lines. Each tape is analyzed by noting the time the vehicle is in use during the day, the time of standing still, distance traveled, speeds during morning, midday and afternoon, total number of stops, and any special items which apply to the particular work which the vehicle is doing.

This study is to be carried over a number of months before any broad deductions are to be made as to the average characteristics of the several classes of service, but by such a comprehensive compilation of operating data it is expected that the demands of these services can be very definitely stated. The relation of running time to standing time appears to be one of the most vital features of the economy of motor trucks as compared with horse-drawn vehicles, and the investigation shows already that the possibility of handling transportation more efficiently by the former depends in large measure upon the extent to which the mobility of the motor vehicle can be utilized. It is expected that many sources of delays will be ascertained by this branch of the investigation, and that as a result trackless transportation will be placed upon an entirely new plane. Some of the general results already indicated in connection with the relation between cost of service and daily mileage were recently given by Dr. Pender and are shown in the accompanying diagram. Dr. Pender pointed out that the number of miles which a truck can be run per day depends upon the limitations of the machine and the limitations of the business or kind of service which it is to perform, and that the chief advantage in the use of a motor truck lies in the greater speed at which it can be run and the greater convenience in handling. Increase in speed, however, effects a saving only in running time, and unless the time thus saved is a considerable portion of the total time and can be effectively used the advantage of a high-speed machine is largely offset. Thus the department has records of wagons which are running only 30 per cent of the time. Were such a wagon replaced by a motor truck having three times the average speed of a horse wagon the time saved would be two-thirds of 30 per cent, or 20 per cent of the total time. This is equivalent to stating that the motor truck would be capable of performing but 25 per cent greater mileage per day than the horse-drawn truck. On the other hand, by cutting down the standing time to 25 per cent the use of a machine having three times the speed would result in a saving of two-thirds of 75 per cent, or 50 per cent of the total time. In this case the machine having the higher speed would be capable of performing twice as many miles per day as the slow-speed machine.

Dr. Pender stated that the most evident field for a motor

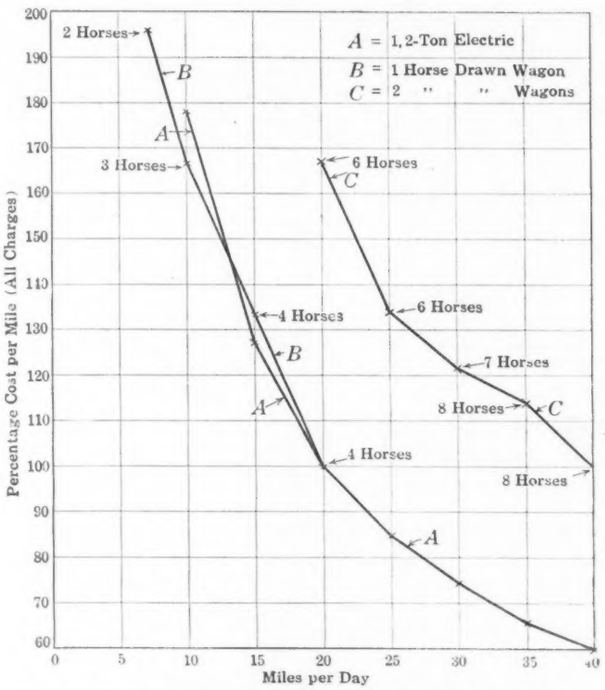


Fig. 3—Curves Showing Total Cost of Operation of Various Vehicles.

truck is in the kinds of service where the standing is a small part of the total time. The diagram shows the relative total cost of operation of a two-horse wagon and a 2-ton electric truck for various miles per day run. In making up the curves it was assumed that a two-horse wagon cannot be expected to do more than 20 miles a day, whereas a first-class electric truck may do 40 miles per day. Hence for a service requiring more than 20 miles per day two two-horse wagons would be required. The curves show in a striking way the advantages of the electric truck over the horse-drawn truck when the service is such that the electric truck can be utilized for the work of two two-horse wagons. In order that this condition shall be obtained it is necessary that the service shall be such that by using the high-speed machine the time of doing a given amount of work shall be cut in half, or, in other words, the service must be such that an electric truck can do in half a day a full day's work of a horse wagon. Furthermore, it should be understood that a very low mileage per day indicates uneconomical use

of either horse or electric truck, and a proper readjustment of conditions would allow the electric vehicle to demonstrate its superiority.

In connection with the trackless transportation investigation the following thesis work is being prosecuted, there being nine senior students in the electrical department engaged in the study: Messrs. H. L. Woehling, K. W. Faunce and R. C. Stobert, "Investigation of the Time-Factors in the Movement of Vehicles at the Boston Freight Terminal of the Boston & Maine Railroad"; Messrs, A. P. Hornor and E. M. Mason, similar investigation at the Boston & Albany Terminal; Messrs. A. H. Rooney and H. E. Soulis, similar investigation at the New York, New Haven & Hartford Terminal; Messrs. J. M. Hargrave and N. A. Hall, "Test on the Energy Consumption of an Electric-Battery Truck Under Various Road Conditions."

The time studies consist of extensive records and analyses of the movement of loading and unloading vehicles at the inward and outward freight houses of the railroad companies. The observations include the determination of the average time taken by the several types of vehicles at different periods throughout the day for entry, backing, unloading, exit and delays. The seriousness of the delays appears from the relation between their length and the total time represented by the sum of the five movements.

The motor-truck energy tests are being carried forward with reference to the pavement conditions encountered in Boston, particular regard being given to the interference with the operation of a machine by snow and non-skid devices. It is anticipated that many other features of motor-truck service will be investigated as an outcome of this work. Information is also being assembled regarding the performance of batteries and tires, accurate comparative data being scarce in this field.

ELECTRIC VEHICLE DEPARTMENT OF THE ROCHESTER RAILWAY & LIGHT COMPANY.

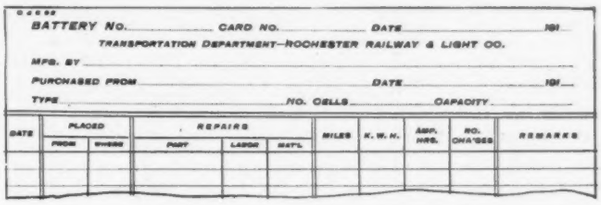
Results of Experience in the Operation of Electric Vehicles—Systems of Inspection and Forms of Report.

IN April, 1911, the Rochester (N. Y.) Railway & Light Company organized a transportation department, to which were transferred the garage and the care and use of all automobiles. The mileage and expenses of the machines, together with an account of the service each car performs, are kept tabulated carefully by the transportation department, and if it is found that better results can be obtained by transferring the automobiles from one department to another, this is done. The larger and heavier machines owned by the company are used for hauling heavy material for all departments indiscriminately, where formerly they were used by individual departments—that is, one truck was used by the gas street department for hauling heavy iron pipe and specials, another by the underground department, another by the overhead department. All automobiles ran on one street to deliver material for each department separately, and in very few cases were the trucks loaded to capacity. These autos have since the organization of the transportation department been taken away from the other departments, and all orders for the delivery of this material now go direct to the transportation department. The latter delivers all material, and there have been times when a 3-ton or 5-ton truck has done the work of three teams.

If any machines are handled carelessly, or the driver is careless, the transportation department refuses to give such a driver a machine even though he is working for some other department. This has the desired effect of making the men careful and cautious when using electric autos.

RESULTS.

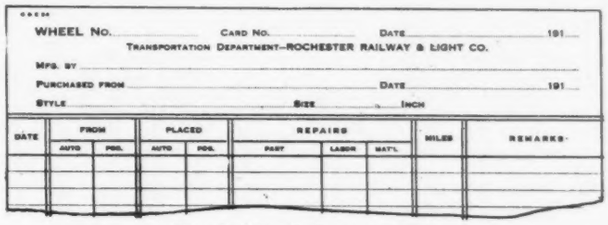
The company's automobiles have given unusually good satisfaction. It will be noted that in some cases the average mileage per day is not as large as one might think it ought to be. In the summer months the machines in some cases


BATTERY NO. ____ CARD NO. ____ DATE ____ 191__
TRANSPORTATION DEPARTMENT—ROCHESTER RAILWAY & LIGHT CO.
MFG. BY ____
PURCHASED FROM ____ DATE ____ 191__
TYPE ____ NO. CELLS ____ CAPACITY ____

DATE	PLACED		REPAIRS			MILES	K. W. H.	AMP. HRS.	NO. CHARGES	REMARKS
	FROM	WHERE	PART	LABOR	MAT'L.					

Fig. 1—Battery Report Blank.

cover as many as 40 miles and 50 miles a day, while in the winter months, when there is not so much work to do, the mileage per day is greatly reduced. Sometimes the average number of days each automobile is in use seems rather small, but where this was the case the automobiles had

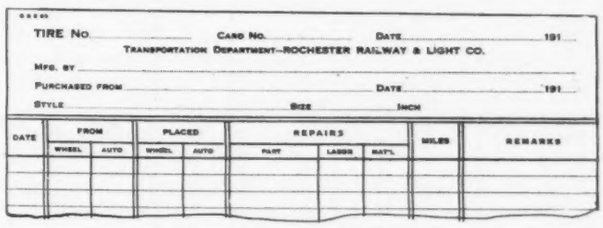

WHEEL NO. ____ CARD NO. ____ DATE ____ 191__
TRANSPORTATION DEPARTMENT—ROCHESTER RAILWAY & LIGHT CO.
MFG. BY ____
PURCHASED FROM ____ DATE ____ 191__
STYLE ____ SIZE ____ INCH

DATE	FROM		PLACED		REPAIRS			MILES	REMARKS
	AUTO	HRS.	AUTO	HRS.	PART	LABOR	MAT'L.		

Fig. 2—Wheel Report Blank.

a general overhauling, after which the necessary repairs were made and they were repainted. Again, it will be noted that in a few cases the cost of the automobile per day is rather high, due entirely to new tires or to new batteries being installed.

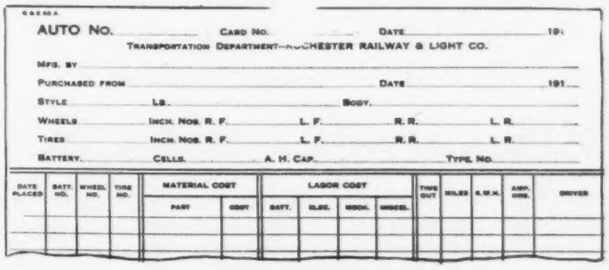
Referring to report of trucks Nos. 6, 7, 12, 13 and 14, it


TIRE NO. ____ CARD NO. ____ DATE ____ 191__
TRANSPORTATION DEPARTMENT—ROCHESTER RAILWAY & LIGHT CO.
MFG. BY ____
PURCHASED FROM ____ DATE ____ 191__
STYLE ____ SIZE ____ INCH

DATE	FROM		PLACED		REPAIRS			MILES	REMARKS
	WHEEL	AUTO	WHEEL	AUTO	PART	LABOR	MAT'L.		

Fig. 3—Tire Report Blank.

will be noted that these have been in use about six years. They are of old design and were formerly used by the police department and two large department stores in Rochester. The trucks were replaced with modern trucks, and after a thorough overhauling were used by the underground depart-


AUTO NO. ____ CARD NO. ____ DATE ____ 191__
TRANSPORTATION DEPARTMENT—ROCHESTER RAILWAY & LIGHT CO.
MFG. BY ____
PURCHASED FROM ____ DATE ____ 191__
STYLE ____ LB. ____ BODY ____
WHEELS ____ INCH. NOS. R. F. ____ L. F. ____ R. R. ____ L. R. ____
TIRES ____ INCH. NOS. R. F. ____ L. F. ____ R. R. ____ L. R. ____
BATTERY ____ CELLS ____ A. H. CAP. ____ TYPE NO. ____

DATE PLACED	BATT. NO.	WHEEL NO.	TIRE NO.	MATERIAL COST		LABOR COST				TIME OUT	MILES	K.W.H.	AMP. HRS.	DRIVER
				PART	COST	BATT.	ELEC.	MECH.	MISCEL.					

Fig. 4—Automobile Report Blank.

ment, where the service required is not severe. The hauls are short, and the machines answer the purpose better than a high-priced truck because they remain idle in the street for hours at a time.

Every electric vehicle replaces from one to two single-

horse wagons and from one to three double-team trucks. The men prefer the automobiles, and can do more work with them than with horses and wagons. Much better results are obtained where the drivers of electric vehicles always handle the same machine, as each driver is interested in keeping his machine in good running order.

In Rochester, before replacing horses and wagons with electric vehicles, the company considered the building of outlying shops, on account of the long distance it was necessary to cart material from the central shop at times. This would have meant extra shop rental, extra shop foremen and clerks, and by using automobiles the necessity for outlying shops has disappeared.

INSPECTION OF AUTOMOBILES.

An inspection card is filled out each night by the driver, who checks off the part that needs repairing, and if no repairs are needed, signs "All O. K." These cards are re-

E 69

R. R. & LT. CO. L–Loose T–Tight DY.–Dry
AUTO No...... A–Adjust R–Replace DT.–Dirt

Inspector's Report **Date** 191

Controller	Fingers	Contacts	Connection	Brakes	Adjustm't	Toggles	Pins
	C.O.S.W.	Snap Sw.	Vaseline		Drums	Lining	
Steering Gear	Oil	Sector	Pin	Motor	No	Packed	Brushes
	Clamp	Adjustm't			Com.	Rad. Rd.	Line Up
Springs	Oil	Links	Clips	Chains	Adjustm't	Oil	Clean
	Leaves	Hangers	Bolts		Morse	Roller	
				Sprocket	Pinion	Gears	
Wheels	Packed	Adjustm't	Spokes				
	Condition			Counter Shaft	Adjustm't	Packed	
Axles	Front	Rear					
Tires	New	Patch		Battery	No	Make	Size
					Cleaned	Miles	
Wiring	Bell	Lamps	Plug	Connection	Jar Cover	Rub Cor	

REMARKS

DATE 191 **SIGNED**

Fig. 5—One Side of Inspector's Report Blank.

checked by the foreman, and repairs are made at night so that the car is ready at 7 o'clock the next morning. The battery inspector also turns in an inspection report of the car if it is damaged in any way or if the car has received hard usage.

The batteries are carefully inspected by the battery man each night. The usual routine consists in reading the gravity of the pilot cell of each battery, watching the charge, and reducing the current according to the temperature and gasing of the battery. All cells of each battery are thoroughly inspected every fifteen days. It is realized that no part of the vehicle needs more attention than the battery and that too much care and inspection cannot be given to it.

As soon as a vehicle needs overhauling it is done thoroughly and at once. Drivers are cautioned not to run in street-car tracks, as this doubles the tire expense. Data on the vehicles of the company and record forms are given herewith.

Trucks Nos. 1, 2 and 3 are used for heavy carting, loading and unloading and each is equipped with a motor-driven

DATA ON ELECTRIC COMMERCIAL VEHICLES IN USE IN ROCHESTER, N. Y.

Truck Number.	Capacity, Pounds.	Months in Use.	Average Miles per Day.	Average Use per Month, Days.	Kilowatt Hour per Mile.	Cost per Day, Dollars.
1.....	10,000	31	16	24	1.5	4.71
2.....	7,000	31	24.5	25	1.14	8.14
3.....	7,000	19	8.5	23	1.91	3.84
4.....	4,000	32	22.5	22	1.16	4.83
5.....	4,000	30	24.5	26	1.82	3.10
6.....	4,000	84	12.5	21	1.43	1.50
7.....	3,000	84	14.5	21	1.22	3.12
8.....	2,000	6	22	26	1.06	1.06
9.....	2,000	24	24	27	.92	3.42
10.....	2,000	24	24.5	24	1.10	8.61
11.....	2,000	22	24.5	23	1.09	3.74
12.....	2,000	72	13	19	1.45	4.31
13.....	2,000	72	15	21	1.28	4.32
14.....	2,000	72	13	18.5	1.52	2.03
15.....	1,000	12	22.5	29	.58	2.06
16.....	1,000	12	24	49	.59	1.64
17.....	1,000	12	25.5	31	.59	2.36
18.....	1,000	12	18.5	51.5	.83	1.15
19.....	1,000	20	19	38.5	.77	1.88
20.....	1,000	72	16.5	23.5	.88	2.77
21.....	1,000	1	22.5	29	.88	.47
22.....	1,000	1	15	30	.90	.51
23.....	1,000	30	27.5	13.5	.63	5.96
24.....	700	8	25	27.5	.48	.61
25.....	700	8	25	28.5	.93	.53
26.....	700	8	31	28.5	.44	.68
27.....	700	8	23.5	28	.54	.69
28.....	700	7	25	31	.92	.51
29.....	700	8	28.5	29	.43	.66
30.....	700	7	30	23	.38	1.40
31.....	700	2	22.5	22	.64	1 17

winch, the energy for which is supplied from the vehicle battery. Vehicles Nos. 25 and 28 are equipped with Edison batteries. Some of the vehicles are oftentimes called upon for twenty-four-hour service. In such cases the batteries are changed.

ELECTRIC-VEHICLE GARAGE IN BROOKLYN.

It is quite generally recognized that electric vehicles do not obtain the best of care when housed in garages given over chiefly to the maintenance of gasoline machines; in fact, it has been found expedient to erect garages intended for the use of electric vehicles exclusively in order that such automobiles may obtain intelligent treatment. In many cities there are enough electric vehicles to justify private concerns in engaging in the electric garage business; in others the central station exercises some supervision over the facilities afforded, while in still others the manufacturers of the vehicles find it to their interest to open garages.

Brooklyn for some time lacked sufficient garages where electric automobiles could be handled, and in order that any electric vehicle campaign might show results it was necessary to remedy this defect. The Edison Electric Illuminating Company of Brooklyn therefore took the matter up with the automobile builders and asked that an investigation of the opportunities afforded by that borough be made, feeling that that, with the rates in force, was all that was necessary to induce a wide-awake manufacturer to establish a garage. The Anderson Electric Carriage Company, builder of the Detroit electric car, was sufficiently impressed with the possibilities to build a sales office and garage at St. John's Place and Bedford Avenue where electric vehicles of the pleasure and commercial types could receive expert attention. The garage, views of which are reproduced herewith, is also used as a distribution point by several New

York houses for deliveries in that section of Brooklyn, and machines other than those of Anderson build are cared for.

Thirty vehicles can be charged at one time and the charging equipment is suitable for charging trucks and cars using the nickel-iron or the lead battery. The equipment and general layout of the garage received deliberate consideration. There are thirty charging outlets, three outlets being grouped at each of ten stands. The station has a very clean and roomy appearance. All lighting circuits are run in conduit and all battery circuits are run from the charging board to the outlets in conduit under the floor. As will be noted in Fig. 3, the charging outlets are located about 1 ft. above the floor.

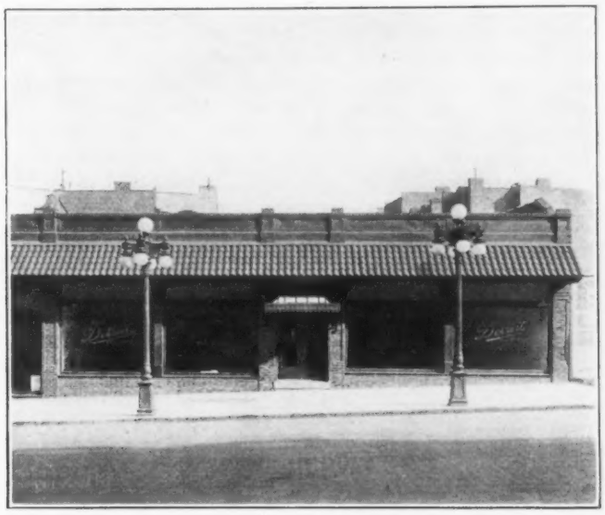


Fig. 1—Exterior of Garage.

The Cutler-Hammer charging rheostat panels shown in the illustration are so designed as easily to be augmented. Each panel is a charging unit in itself except the one at the right. This panel carries at the bottom a three-pole main-line knife switch and fuses, one charging unit for charging three cars, an additional charge-discharge switch for discharging any battery on the circuit through the charging rheostat, and a charging rheostat for charging ignition batteries. The small swinging panel carries the voltmeter and a zero-center type ammeter which indicates in one direction on charge and in the other on discharge.

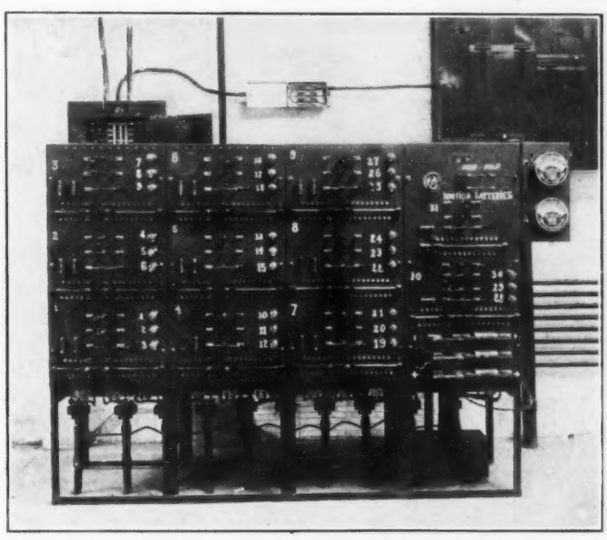


Fig. 2—Charging Board.

The other three panels are all alike, each being a complete frame so that when more charging outlets are required it will not be necessary to make any changes on the original equipment. The only connections between the frames are the main busbars, which are mounted near the top of the back of the panels. The connections to the battery-charging circuits are made at the bottom of the panels.

The three outlets at each of the ten charging stands are connected in series, and these can be connected by means of a double-pole, double-throw switch to either the 110-volt or the 220-volt circuit. If only one car is being charged, the switch is closed in the 110-volt position. When two cars are being charged at the same rate, they can be connected in series on the 110-volt circuit, at least for starting the charge (unless the combined counter voltage of the batteries is in excess of 110 volts). For finishing the charge the batteries are connected on the 220-volt circuit. By this means less energy is wasted in the resistance of the rheostat. For three cars the switch is thrown in the 220-volt position for the entire charge. The fact that the three outlets of each stand are connected in series does not prevent cutting out any car. Another may be substituted, or the vacant outlet or outlets may be short-circuited by means of plugs provided for the purpose.

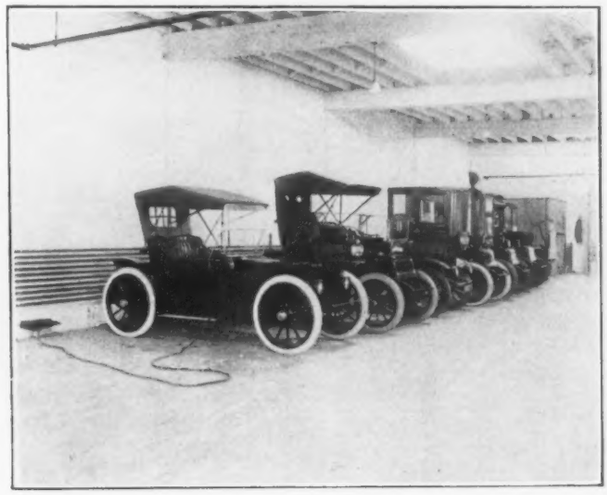


Fig. 3—Vehicles on Charge.

One pilot lamp is provided for each outlet which burns when the battery is plugged in, indicating to the attendant at the board at all times the outlets in use.

The double-throw switches of the charging panels are arranged so that in the 110-volt position, with all circuits in use, the system is balanced, half the switches being connected to one side of the three-wire system and half to the other side.

The rheostats are arranged for a large number of steps over a wide range to secure fine regulation. Each rheostat except the one designed for charging ignition batteries has two sliding contact arms, one of which provides for the large steps and the other for the fine adjustments of current. Ten steps of the latter equal one of the former.

Each circuit is provided with a single-pole ammeter switch, giving a reading on its particular circuit. This switch is designed so as not to break the circuit during the period of throw-over. The reading obtained, therefore, indicates the exact condition of the battery. The garage is supplied with energy over a three-wire, 230-115-volt service from the Edison Electric Illuminating Company of Brooklyn. The garage has been only recently established so that its facilities are not taxed to the limit. A flat rate of $40 a month is charged for the care of a pleasure vehicle. For this the company obligates itself to deliver the car to the owner fully charged; to wash the vehicle and make weekly inspections of the battery, etc.

COST OF CENTRAL-STATION PRODUCTION AT FALL RIVER, MASS.

Records of station performance drawn from the practice of electric lighting and power companies recently equipped with new plants are often suggestive. Minimum cost per unit of energy delivered at the busbar is a primary object of the central-station industry. Although economies in the distribution system are of great importance on account of their multiplication back to the fuel pile, the initial cost of production within the station is the starting point of all permanent economy of service and is therefore of interest even though it excludes many important factors entering the total expense of generation. The following figures show the net station cost of electrical production at the new turbine plant of the Fall River (Mass.) Electric Light Company for the year ended June 30, 1911. The figures include labor and supplies, fuel and water, and repairs to building, steam and electrical equipment only, and represent, not the total cost of production on the company's system, but the so-called net manufacturing expense at the plant. Interest, depreciation, taxes and all other fixed charges are omitted, the object of the tabulation being simply to show the equipment performance in a turbo-alternator plant of recent design, which has superseded an older and less efficient station which formerly served the community.

The equipment of the plant consists of six 350-hp water-tube boilers, each having 168 4-in. tubes and three steam turbines, one being rated at 500 kw and the others at 1000 kw each. A 4000-kw unit was in process of installation as the year closed, but was not a factor in the production of energy during the period covered by the table. An extensive installation of motor-driven auxiliaries is in use in the station, together with a modern coal-handling system. Fuel is delivered to the station by water transportation. The total output of the plant at the switchboard for the year was 5,764,466 kw-hours. The company sold 4,316,984 kw-hours, of which 1,230,960 units were delivered to electric motors. Street lighting required 1,276,678 kw-hours. The maximum load upon the plant was 2355 kw, and the fuel consumption for the year was 7726 tons of bituminous coal, the average cost per ton consumed being $3.67. The load of the plant is given in Table I.

TABLE I.—CONNECTED LOAD.

	Kilowatts.
856 4-amp magnetite street lamps	321
Commercial arcs	233
Municipal incandescents (420 40-watt tungstens)	17
Commercial incandescents	3,306
Total connected lighting load	3,877
Connected load, other companies	196
Electric motors	1,757
Total connected load	5,830

The bare cost of manufacture at the station, exclusive of fixed charges, is given in Table II.

TABLE II.—MANUFACTURING COST.

Coal	$28,332
Oil and waste	633
Water	747
Wages (sixteen men)	13,329
Building repairs	5,537
Steam equipment repairs	1,555
Electrical equipment repairs	109
Tools and appliances, miscellaneous	1,598
Total cost of fuel, labor and supplies	$51,840

The unit cost per kw-hour delivered at the switchboard was 0.49 cent for fuel, 0.23 cent for wages and 0.18 cent for supplies and repairs, the total net station cost per kw-hour, exclusive of management, distribution, fixed and any other expenses than the bare cost of transforming the "raw material" of the plant into electrical energy, being 0.90 cent. The load-factor of the plant for the year was 28 per cent, the average continuous load upon the equipment being 656 kw. The station-factor, or ratio of average load to installed capacity, was 26.2 per cent. The business of the company is growing rapidly, particularly in the power field, and it is probable that the cost of production will be still further reduced in the future if the cost of fuel and that of labor remain near their present levels, and if the cultivation of the off-peak load continues along the lines which the management is at present working. The above data indicate that even moderate-sized central stations should be able, with favorable fuel costs and modern turbine equipment, to cut the net expense of production per unit of energy delivered at the bus to within 1 cent. The actual cost of delivering energy to the consumer and other costs of the electric service are, of course, to be added to obtain the total cost of service, but as a criterion of station performance the simple analysis above given is a useful method of investigating the economies of electrical production.

NEW COAL-WAGON HOIST FOR MILWAUKEE STATION.

The Milwaukee Electric Railway & Light Company is now installing a third large motor-driven coal hoist at its Commerce Street station, where the practice is followed of picking up the loaded wagon-boxes of its horse-drawn coal trucks, raising and dumping the contents of these directly into the bunkers. The new traveling hoist, which picks up

Delivering a 5-Ton Wagon-Load of Coal to Bunkers.

wagons from the alley side of the plant, is arranged with two motors, a 150-hp unit for hoisting and a 20-hp motor for the trolley travel. The hoist is capable of raising its 8-ton load at a lineal speed of 250 ft. per minute.

The wagons used for hauling coal to the plant are, of course, of a special type, with their boxes built separate from the frames and trucks, but arranged with latches which rigidly connect the two parts when fastened. As coal is delivered to the plant the three-horse trucks are spotted under the hoist and the sheave-hooks dropped to engage the hoisting chains on the wagon-box. The box, driver's seat and all, is then hoisted directly into the air through the total lift of 65 ft., and the trolley is run in on

its I-beam rails over the bunkers and dumped by means of the pair of hooks seen in the accompanying illustration. The operation is controlled by an operator in a cab on the trolley structure. Dynamic braking is provided against too rapid lowering. The new hoist, which, like the other two, was built by the Pawling & Harnischfeger Company, Milwaukee, is arranged to hoist the wagon-box parallel to the building wall from the narrow alley, where it is impossible for teams to turn.

BLEEDER OPERATION OF TURBINES FOR ADRIAN HEATING SYSTEM.

One of the first steam turbines to be adapted for bleeder operation in connection with a steam-heating system was a 500-kw Westinghouse single-flow three-stage unit installed in 1907 in the plant of the Citizens' Light & Power Company at Adrian, Mich. Here the steam supply for the heating system was bled off at 3½ lb. per square inch back pressure, from a point intermediate between the first and second stages. The rest of the steam passed through the two remaining stages and was discharged to the 27-in. vacuum produced by an Alberger surface-type condenser. The bleeder feature of this unit was specially improvised for the Adrian plant, and consisted simply of a standard pressure-diaphragm-operated valve admitting the partially expanded steam from the turbine into the heating line when the latter's pressure fell below that set for by adjusting a counterweight. This unit has been in service continually ever since, and when operating on the heating system has averaged a plant efficiency of 7 lb. of coal per kw-hr. This early turbine was, of course, not designed for such bleeder use, and as its secondary valves at times operate to admit 150-lb. boiler-pressure steam into the second stage, this steam was delivered practically direct to the heating system without an opportunity to do expansive work. The Westinghouse turbine drives a 500-kw, 2300-volt, 60-cycle, three-phase alternator, with a small direct-current exciter mounted on the same shaft.

Following the successful bleeder performance of this

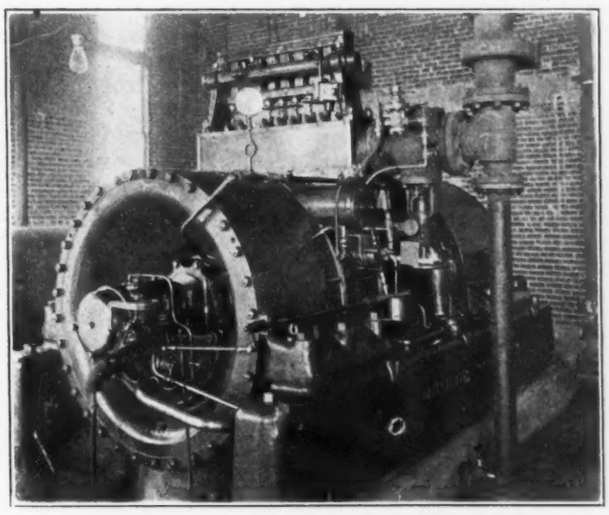


Fig. 1—1000-kw Bleeder-Type Steam Turbine.

500-kw turbine, the growth of the load had by 1911 dictated the installation of a 1000-kw set (Fig. 1), which has been running at Adrian since last November. This 1000-kw horizontal Curtis unit is equipped with the Lynn valve gear, comprising a rocker mechanism which adjusts the steam admission by opening to full port only the number of valves necessary to carry the load on the turbine. All valves while in use are thus wide open, and with successive slight load changes the next valve in the series is kept oscillating between its open and closed position. This turbine is of the two-stage type, the middle point operating at about 3½-lb. gage, for admitting steam to the heating system. Steam at 150 lb. pressure and superheated 100 deg. Fahr. is supplied to the initial stage by 1500 hp of Stirling boilers. In

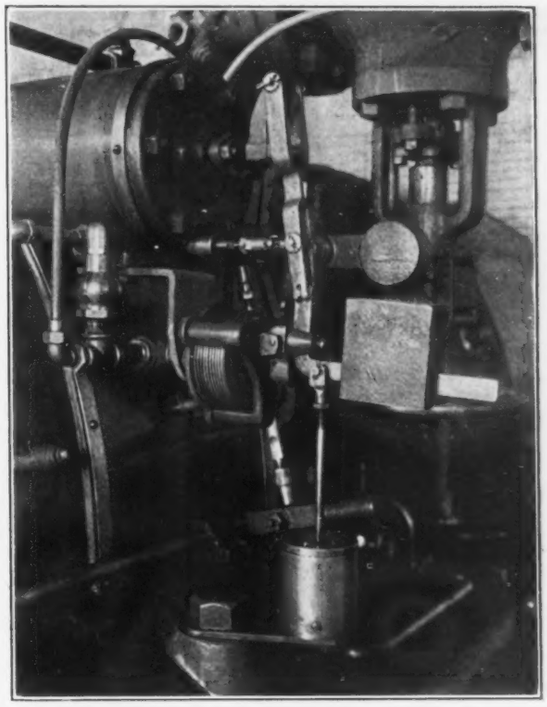


Fig. 2—Improved Bleeder Regulating Valve.

the case of the 100-kw turbine, again, the bleeder regulating valve gear was improvised on the spot from such spare parts as could be located in the town. This rigging is illustrated in Fig. 2. A corrugated copper-cylinder pressure diaphragm connected to the heating mains provides the regulation, acting, through the system of levers shown, on the pilot and bleeder valves. Undue motion of the bleeder-valve system is damped by the dash-pot below. The low-pressure stage of the 100-kw turbine exhausts into a Wheeler surface condenser, supplied with cooling water from a stream near the plant. A separate small General Electric turbine-driven exciter has been provided for the new unit, but is not in use. Exhausting into the heating system from its intermediate stage at 3½ lb. back pressure, the 1000-kw turbine has developed a plant efficiency of 5¼ lb. of coal per kw-hr. The large unit is now operated continuously twenty-four hours per day and carries an evening peak of 800 kw. A number of fence factories make up the Adrian system's day load, which averages 450 kw throughout working hours, contributing to the coincidence between the electrical and heating demands.

MELTING OF BRASS BY ELECTRICITY.

The National Cash Register Company, of Dayton, Ohio, whose factory output averages a completed machine every ninety seconds, is planning to melt all of its brass by electric heat, entailing the installation of about 2000 kw in electric furnaces. The Dayton Lighting Company purposes to furnish the energy for this purpose, and it is expected that the furnace load can be controlled so as to be limited to the off-peak hours of the central-station system, including "filling" for the noon valley in the power load curve.

Letters on Practical Subjects

MAKING A WATERPROOF FLOOR OF CONCRETE.

Recently we undertook to put in a waterproof floor of concrete in a basement below the standing level of a nearby stream. Heretofore in finishing up such a job I have inserted narrow wood strips in the joints when the concrete was being poured, pulling these after the material had set and calking the crack tight with oakum. In the present instance, however, I tried a narrow filling of plaster in the crack. After the concrete had hardened the plaster was scraped out with a sharp tool and the oakum calked into place in much the same way as a ship carpenter makes his vessel's hull watertight. The result was a perfectly watertight job, and the temporary plaster filling proved much easier to handle and remove than the wood formerly used.

Erie, Pa. P. T. Coburn.

THE RIGHT WAY TO PLACE PROTECTING TUBES.

A tube for protecting a wire where it crosses another wire should always be so placed that the tube will not force the unprotected wire against the surface supporting the conductors. The tube should always be on the inner wire. If placed on the outer wire the tube may force the unprotected wire against the surface as shown in Fig. 2. Oftentimes porcelain tubes are used on wires crossing each other in boiler-rooms or locations having steam pipes. It is readily seen that if the porcelain tube is placed on the lower instead of on the upper wire it would force the upper wire against the hot pipe, with the result that the insulation would be quickly destroyed and a ground or short-circuit ensue. Serious damage has been known to result from just this cause.

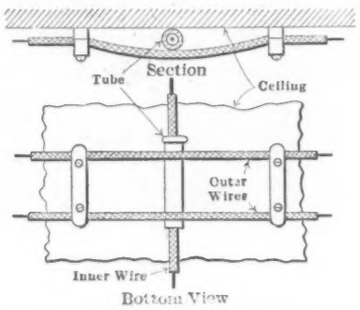


Fig. 1—Correct Method of Placing Tube.

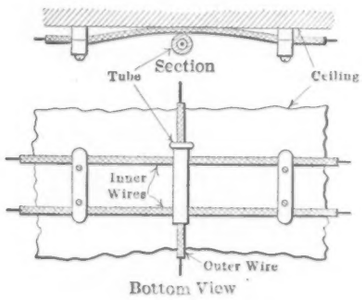
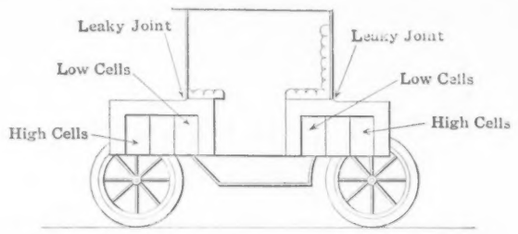


Fig. 2—Incorrect Method of Placing Tube.

Columbus, Ohio. George Converse.

ILLUSIVE CELL GRAVITIES DUE TO LEAKY BATTERY BOXES.

When investigating the condition of a vehicle battery with a hydrometer, one should not overlook the fact that the rear cells of the front group and the forward cells of the rear group are likely to have a lower specific gravity and output than the others, caused by the entrance of drippings from the bonnet housings when the car is washed. If special attention has not been given to this feature in the design of the car body, water containing soap or soda will find its way into the battery chambers, affecting first the rows of cells toward the center of the car where the injury is most likely to go unnoticed. This water dilutes the acid and, if soapy, neutralizes it by the addition of alkali, while the foreign material washed into the cells sets up local actions which discharge the plates. As a result these inner cells may have their output greatly reduced, even becoming reversed on heavy discharges, although the attendant is meanwhile obtaining satisfactory hydrometer readings from the most easily accessible cells and probably assumes the whole battery to be in the same excellent condition. Estimates of battery condition based on the outer rows of cells may therefore be entirely misleading as far as the whole battery is concerned, and hydrometer readings of a cell in each row should be taken from time to time. If possible, of course, the battery boxes should be, once for all, protected against the entrance of water from showers or careless washing.

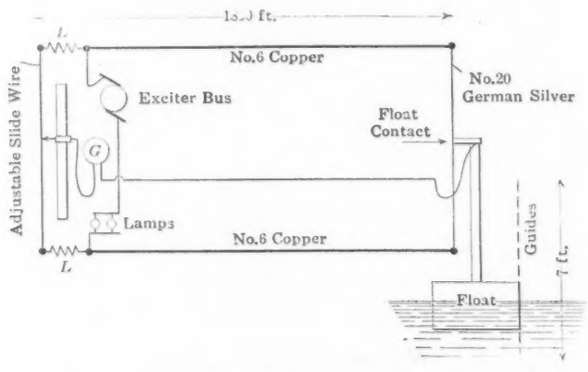


Effect of Improper Weatherproofing of Battery Boxes.

Indianapolis, Ind. L. G. Clancy.

INDICATING WATER LEVEL IN DISTANT FOREBAY.

To gage the water level in the forebay of the St. Croix Power Company's plant near Somerset, Wis., it was formerly necessary to dispatch an observer to read a float 1800 ft. distant from and 80 ft. above the power house. Besides the loss of time and the annoyance of going to and fro, frequent readings of the forebay level were out of the question. Use of the Wheatstone bridge principle, as illustrated in the sketch, now enables the switchboard operator to read directly any change in level, down to ¼ in., occurring within a vertical range of 7 ft. The galvanometer contact carried by the float bears against a No. 20 German silver wire similar to the adjustable slide wire in the plant. No. 6 copper wire is used to connect the two arms of the bridge, resistance being inserted at L and L equivalent to the resistance of the line wires. The 125-volt exciter bus, connected through lamps, is used as the source of current. To read the water level at the float, the adjustable slide in



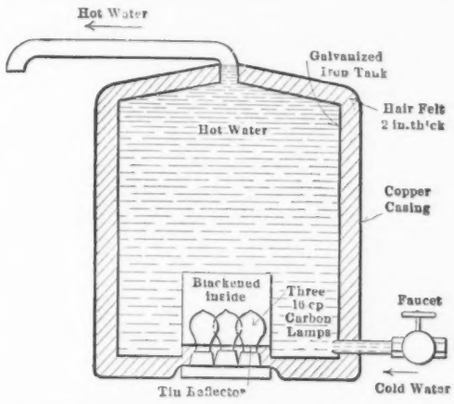
Wheatstone Bridge Used to Indicate Forebay Level.

the plant is moved until the galvanometer shows no deflection, indicating that the two contacts are in equivalent positions. The gage height can then be read directly from the station pointer position. As will be evident from the bridge arrangement, the main current path is a closed circuit at all times, and the operation of the scheme is independent of the quality of the contact at the float. Including the galvanometer, this gage level device cost $150 to install and has repaid its value many times. The plan was suggested and carried out by Mr. F. R. Cutcheon and Mr. John Pearson, of the St. Croix company.

St. Paul, Minn. G. R. Smith.

A HOME-MADE HOUSEHOLD WATER HEATER.

The summer household which is to cook its food electrically with economy and satisfaction should have a ready supply of hot water, without waiting to heat cold water over a high-demand stove unit. For his own home Mr. H. A. Fee, manager of the Citizens' Light & Power Company, of Adrian, Mich., has constructed such a simple, effective long-hour water heater out of an insulated 6-gal. tank and three 16-cp carbon lamps. Its construction is clearly shown in the sketch. To insure long life the lamps are run below rated voltage, and beneath them is a bright tin reflector, returning all downward heat rays up into the blackened lamp-chamber interior. This water heater is



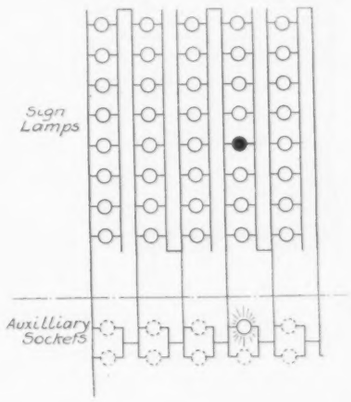
Section Through Home-Made Water Heater.

operated day and night during the summer when the Fee household cooks with electricity, and it supplies all the hot water needed for the family of five, including the small-quantity requirements of the bathroom. The water is kept at nearly boiling temperature and sometimes steam is formed, indicating that the tank might well be made a little larger or less wattage used to deliver the same service. From the central-station standpoint Mr. Fee believes that such a continuously connected heater could be operated profitably at an expense of from $1 to $1.25 per month, providing a desirable long-hour summer load.

Chicago, Ill. O. H. Shea.

A "KINK" TO SAVE LAMPS ON SERIES-MULTIPLE CIRCUITS.

Where only direct current is available in downtown sections it is often necessary to use the series-multiple arrangement of low-voltage tungsten sign lamps. Such connections have given a great deal of dissatisfaction and annoyance by their rapid destruction of lamps following the burning out of one unit. As soon as the one filament breaks an excess current and corresponding voltage are imposed on all the other lamps of the same group, burning the remainder at increased brilliancy until the weakest lamp is destroyed. This again aggravates the condition and all the other lamps of the group then follow rapidly to their destruction, quickly interrupting the circuit and extinguishing the whole display. To prevent the trouble, of course, the first lamp should be replaced immediately it is seen to be extinguished, for the wholesale destruction of the group can thus be nipped readily in the bud. In many large roof signs and inaccessible displays it is out of the question to get ladders and go up on to the sign after dark to replace a



Method of Protecting Lamps in Series-Multiple Sign Circuits.

single lamp. In such cases I have found it convenient to have the wires from each group of small lamps in multiple extended down to two or more sockets mounted in the roof-house or other easily accessible place. These sockets should be carefully labeled with the group to which they belong. Then as soon as a lamp on the sign is seen to be out, and its fellows making an effort to re-divide the load among themselves, it is only necessary to insert a new lamp in one of the auxiliary sockets of the same circuit, again equalizing the current flow to its normal value. This will save the remaining lamps of the group as well as the operation of the whole display itself, and next day or once a week a man can go aloft to replace the accumulation of burned-out lamps. The remedy is inexpensive, only one wire being required from each group.

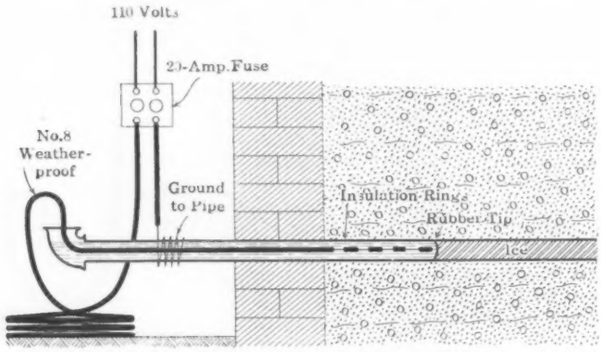
Milwaukee, Wis. Gustave Zimmermann.

THAWING WATER-PIPES WITHOUT A TRANSFORMER.

Sometimes a frozen water-pipe is to be thawed out in a place where no primary connection or transformer is available, or where it would be more expense and trouble to set up the transformer equipment than the single thawing job is worth. In such cases the method used by Mr. E. W. Erick, of Canby, Minn., may be useful, although a little more time is required to do the thawing than by the usual scheme.

In freezing several ¾-in. service pipes in the winter Mr. Erick used the contents of the pipes themselves as water rheostats, making the exposed end of a No. 8 weatherproof-insulated wire act as one of the electrodes. As shown in the sketch, several rings of insulation were cut from the wire to expose its copper surface, while a rubber tip was attached to its end, serving to keep the metal from contact with the pipe which was connected to the other side of the line. Through the water path thus afforded 110 volts forced a current of from 15 amp to 20 amp, delivering 1.5 kw to 2.0 kw near the front of the ice plug. In one instance 16 ft. of ice in a ¾-in. pipe was thawed out in four and one-half hours, a boy being left to feed in the wire as the ice front retreated. The circuit was protected by a 20-amp fuse, so that no damage could result from accidental short-circuit. This distance of frozen pipe was, of course, exceptional and was due to several days' delay in calling for assistance. As the water-rheostat method thaws at the rate of 3 ft. or 4 ft. an hour, only a short time is required to clear the usual foot

or so of frozen plug. This scheme is applicable, of course, only to straight lines, but as the majority of service pipes are included under this, the method will be found effective in most cases. The natural slope of the pipe toward the street drains the water toward the point where it forms the heat-producing path, but if the entry is quite level, a vertical



Thawing Water-Pipes with 110-Volt House Circuit.

elbow may be attached at the cellar end. In any case the street valve should be made ready to turn off the supply when the ice plug melts and the water comes with a rush.

One man can set up the simple apparatus needed to thaw pipes by this method, and a boy can feed in the wire after the operation is started. The expense of a line gang, transformer wagon and team and the usual electrical apparatus are all avoided, and the trouble and danger of making primary connections are eliminated. For use next winter Mr. Erick has ordered a cartridge-type heating unit of a diameter small enough to be pushed into the pipe, and believes that this will prove more efficient than the simple electrode. To thaw the 16-ft. ice plug above mentioned, 8 kw-hr. to 10 kw-hr. was required, costing about $1 for energy, in addition to which was charged the time of one man.

Minneapolis, Minn. L. N. Jones.

PECULIAR LINE TROUBLE.

Below is given an account of a peculiar break-down on a certain high-tension system. The trouble occurred on a series transformer tested to 30,000 volts and working on a 17,000-volt, three-phase system having a grounded neutral.

Fig. 1 gives the "lay-out" of the lines, etc. Station *A* is a point of generation with a grounded neutral; at *B* are three single-pole stick-line switches; *C* is a switching station and *D* is a generating station with delta connections. On the *A* side of *C* are several other generating stations as well as some on the *D* side, none of which are shown. In order to do some work on the line between *B* and *C* this section of the line was to be "killed." The plants on the *D* side of *C* were ordered to back down their governors until no current could be detected flowing at *C*. The operator at *C* was to open the line on the oil switch at his station as soon as the load condition became right. The load

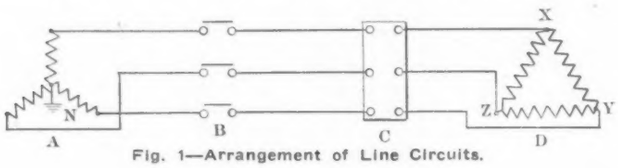


Fig. 1—Arrangement of Line Circuits.

was backed down as ordered, but for some reason the oil switch at *C* failed to open. A lineman who had previously been stationed at *B* received permission to proceed with the opening of the lineman's switches. This he did, as customary, by pulling out one leg at a time. Since the oil switch at *C* had failed to operate, the system was actually being separated one phase at a time. Nothing happened when the first switch was pulled, but on disconnecting the second one the insulation on a series transformer on the line *X* at *D* broke down and the graphic ammeter on the neutral *N* at *A* indicated a large flow of current to the ground at this instant.

The cause of the break-down has been explained in this way: From a consideration of Fig. 1 and Fig. 2a it is to be noted that before the lineman's switches were opened the generating stations *A* and *D* were actually connected as at Fig. 2a. Now, as soon as the lineman opened the second switch at *B* the complete electrical circuit was broken, and the generators on one part of the system began to gain in

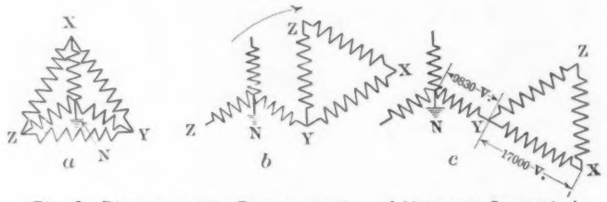


Fig. 2—Diagrammatic Representation of Voltages Generated.

speed on the ones on the other. Figs. 2b and 2c show diagrammatically how the emf generated at *D* gradually pulled out of phase with that generated at *A*. Finally, the emfs assumed the position shown in Fig. 2c, in which position the maximum effective difference of potential between the grounded neutral *N* and the line *X* is possible. In approximately this position the insulation of the series transformer broke down. The effective voltage between *X* and the ground at this instant was equal to the normal system line voltage (17,000) plus the line voltage divided by 1.73 (9830), a total of 26,830 volts. The maximum instantaneous value of the difference of potential of the above two points would be equal to the maximum effective voltage multiplied by the square root of two; that is, $26{,}830 \times 1.41 = 37{,}800$ volts. The above is deduced from the expression: Effective voltage = maximum voltage $\div \sqrt{2}$ as applied to true sine wave emf curves.

Los Angeles, Cal. C. E. Howell.

LEAD BURNING AND THE CARE OF STORAGE BATTERIES.

Lead burning to an outsider seems to be a very interesting yet difficult process. The methods employed by the expert in garage work are briefly set forth in what follows, any anyone mechanically inclined can apply the methods quite readily and effectively. In assembling a new battery the expert, as he has a finely adjusted flame so that it comes down to a point, cuts off the lugs of the plates almost even with the top of the straps, melts the lead of the lug and strap into one piece and then fills up the cavity created by melting into it some soft lead. A method which can be used with almost any kind of flame is as follows: Cut off only about half of the lug, place all the lugs of the plates into the holes in the strap made to receive them, then place the whole into a burning box as pictured in any of the battery companies' instruction books. Now apply the flame to the top of the part of the lug which remains and gradually melt it down until it becomes a part of the strap itself. This method has an advantage over the preceding method in that no soft lead is used, and further the flame does not touch the strap nor heat it nearly so much as the lug itself. Strips of iron may be laid alongside of the strap to prevent any running of lead.

In burning on connectors use is made of thin asbestos paper, which may also be used in burning as described above. The paper is dampened and a piece laid alongside of the lead to be burned. If it be a pillar strap connector, wrap the asbestos paper after it has been dampened around the end of the connector. This will prevent any overflow

of lead. As the paper sticks to the lead, it may be removed with a damp cloth.

A few hints are added which may prove advantageous to the novice in washing a battery. The sealing compound is removed with a hot putty knife or similar tool. The element is then taken out after the straps have been taken off as suggested in instruction books, etc. As is usually the case, the tops of the negative plates are covered with a mossy "growth" of negative material. This has probably been caused by an overcharge or too heavy rate of charge, and must be removed. In order to do this procure a piece of wire, flatten one end and scrape the top of each plate. Remove the elements one at a time, washing it with a hose and examining carefully for any short that may exist. Do the scraping with the wire as described above, and after washing out the sediment the element may be replaced. The acid may be kept or new acid used. Sometimes the negative plates are pressed by placing flat pieces of wood between the plates and placing the whole of the negative part of the element thus arranged in a vise. This is advisable in case they seem to be swollen. New separators may be put in if the old ones seem to be badly used up. To remove sulphate do not scrape the plates, but give the battery a long overcharge. By scraping the life of the battery is greatly impaired.

Before beginning the washing process the battery must be fully charged, and then as soon as possible after washing if the positive and negative plates have not been separated put in about 1300 deg. acid and place the battery immediately on charge. If the plates have been separated, it is probable that they have become discharged somewhat and acid of lower specific gravity may be put in (1250). This can be found out only through experience. Watch each cell carefully to see that it is working while on charge. If one is found to be still, the element should be removed and examined for short-circuit. When the battery is fully charged the covers may be sealed on again and the connectors reburned after all the lead near the place where the joint is to be made has been carefully scraped. Care must be taken to connect each cell + to —, etc. The first charge after the washing should be a long, slow charge.

With the aid of a few catalogs and instruction books from the standard-battery companies, and by following the few hints given above, anyone should be able to become a lead burner in a short while, and by observing the action of different batteries in different stages soon learn enough to attend to the battery intelligently.

Beloit, Wis. M. Mayer.

UNECONOMIC ISOLATED-PLANT OPERATION.

The writer is familiar with an isolated lighting plant where two high-speed engines, rated at 150 hp each, are connected by clutches to opposite ends of a shaft driving four pulleys through friction clutches. Two of these four pulleys are belted to two 125-volt direct-current generators, and the other two to two constant-current direct-current generators for arc lighting. These two engines and four generators could therefore be operated in any desired combination. During the writer's experience with the plant the custom was to operate one engine, one constant-voltage generator and one constant-current generator simultaneously, keeping the other machines as reserve for emergency.

Although this plant was centrally located in an establishment having use for power in small units at various distributing points, this power was obtained from small steam engines. Steam at 80 lb. pressure was piped from the central boiler plant near the dynamo room to these small engines, one of which, the most remote, was a pump engine on the river bank nearly a quarter of a mile from the boilers. It is needless to say that, in spite of all the heat insulation that could be given these pipes, the steam was little more than hot water on reaching some of the engines. The economy of the latter, or rather their lack of economy, can be easily imagined.

The operation of the electric-lighting plant and one 2-hp motor was under the charge of an electrician, and that of the boiler plant and all the other machines was supervised by a mechanical engineer. Both of these employees reported to the superintendent of the institution, who professedly knew nothing of the details under the charge of either. The superintendent expected results and was satisfied when the lights were steady and reliable and the various machines about the plant operating when needed.

The coal bills were appalling, and the superintendent insisted strenuously on more economical firing. The mechanical engineer blamed the dynamo room and the heating system for the consumption of the major portion of the steam, the dynamo room coming in for the larger portion of the blame. The electrician was young in the business and not too self-confident. He, however, had an inkling of the truth, and laid before the superintendent a general plan for discontinuing the obsolete arc machines, the old open-arc lamps with series arc circuits, and all the small engines, installing instead constant-voltage inclosed-arc lamps and motors. He presented some figures to prove that increased economy and improved service would be effected by these changes. His figures were not, however, as complete and convincing as they might have been, or different results would have followed.

The mechanical engineer was skeptical as to the reliability of motors. He had tried a motor several years before, failed to make it operate satisfactorily, and had substituted an engine; hence, in his mind, all motors were sources of trouble and were to be used only as a last resort. Being the older employee, his opinion had the more weight and the system was not changed.

The foregoing is illustrative of hundreds of small plants still operating under obsolete and uneconomical conditions because some one in a responsible position is too conservative. This plant, if properly installed and operated, could doubtless have reduced its cost for light and power 50 per cent and in addition to this would have greatly improved the power service.

Had a reliable central station been available a better plan yet would have been to make a contract with it for all the energy needed for light and power, reserving possibly a portion of the isolated plant for emergency operations and discontinuing all the rest. This plan would have relieved the institution in question of all inconvenience and annoyance of operating its own lighting plant, while probably still further decreasing the cost and increasing the reliability of the service.

In this day of active central-station work, when these stations are showing so much willingness to co-operate with industrial plants, no excuse remains for the employees of any plant to remain in ignorance of the possibilities with the most satisfactory power known. Any progressive central station, and most of them are awake to their opportunities, is willing to co-operate with any industrial plant in its territory in determining the relative economy of operating with electric power from a private plant and with central-station power, or with power from either source with line-shaft and engine drive, steam, gas, gasoline or oil.

Of course, the central station does not do this in a spirit of philanthropy, but in the full understanding that it can present a very strong case for electric drive with central-station power. The implied understanding is that when the facts and figures are so convincing that no further doubt can remain as to the advisability of using central-station power a contract will be placed. In numerous cases the last vestige of doubt is removed by a practical demonstration in which the central station takes all the chances and runs all the risk.

East McKeesport, Pa. D. E. Carpenter.

Questions and Answers

A direct-current generator has four poles, two brushes 90 deg. apart, wave-wound armature, and the commutator has thirty-one segments What three segments must be tapped to get three-phase current?
C. M. H.

Numbering the commutator segments consecutively from one to thirty-two, the coils are interconnected between segments 1, 17, 2, 18, 3, etc., and the proper segments for tapping would be 1 or 16½ for A, 6⅙ or 21⅔ for B, 11⅓ or 26⅚ for C. Fractional segments cannot be reached. In any practical case connection would be made to segment 1 for A, segment 6 for B and either segment 11 or segment 27 for C.

At what frequency does a telephone diaphragm vibrate? One authority states that it vibrates not over 2000 times per second, while another claims that it vibrates 5000 times.
P. C. E.

In making calculations on telephonic transmission circuits, it is customary to consider that the mean frequency is about 800 cycles per second. However, it is well known that in the so-called voice currents there are superposed currents having very much higher frequencies than the fundamental which serve to differentiate the voice of one person from another. These frequencies probably exceed even 10,000 cycles per second. However, it is often assumed that speech can be properly transmitted by apparatus which will convey frequencies up to only 4000 cycles per second.

It is desirable to convert a single-phase transmission line 2 miles in length, consisting of two 400,000-cir. mil. cables, to a three-phase line by installing a single No. 4-0 cable, a large amount of which is now on hand. Is there any practical reason why this smaller cable could not be run as the third leg of this transmission line? The emf of this line is 2300 volts, 25 cycle, and about 300 kw is transmitted. The receiving end of the line will be connected to a synchronous motor, the generating end being connected to a high-tension transformer.
L. C. R.

Although it is usual for the three wires of a three-phase transmission circuit to be of the same size, yet this is not absolutely essential. Generally satisfactory results can be obtained by combining one No. 4-0 cable with two 400,000-circ. mil cables. Except so far as there will be a slight change in the losses, no practical difference could be detected between the operation of such a mixed line and one consisting of either three No. 4-0 cables or three 400,000-circ. mil cables.

What protection has one who has made application for a patent in case he should proceed to manufacture and offer the article for sale pending the granting of the patent? That is, could he take any action to prevent others from making and selling the article during this period?
B. W. M.

A patent issued by the United States government is supposed to provide an absolute monopoly for the inventor, covering the invention as specifically claimed in the patent, for a period of seventeen years dating from the date of issue. It would seem that any person is at liberty either to manufacture or use an article for which a patent is pending, but he must cease manufacturing or using this article immediately upon the issue of the patent. In case he fails to do so, he must render an accounting to the patentee after the matter has gone through a certain amount of litigation. It is customary for articles built in conformity to a patent that has not yet been issued to be marked "patent pending"; such a marking merely warns persons that in all probability at some later date there will be issued a patent which will prevent the manufacture, sale or use of a similar device. It would seem, therefore, to be wise for a person applying for a patent thus to mark the article, in case he offers it for sale before the date of issue of the patent.

Can you direct me to information relative to the design and construction of a releasing plunger electromagnet to operate in series in one lead of one phase of a 220-volt, two-phase induction motor? The normal current used in running a punching machine to which the motor is connected is 18 amp, but when the machine is punching iron the current increases to 26 amp. The arrangement should be such that the plunger will remain stationary with a current of 18 amp but will be raised when the current increases to 26 amp.
J. F. M.

The characteristics of alternating-current magnets of both the single-phase and the polyphase type were well discussed in articles by Mr. D. L. Lindquist which appeared in issues of the *Electrical World* dated June 23, 1906, page 1295; July 21, 1906, page 128; Sept. 22, 1906, page 564, and Oct. 27, 1906, page 811. The magnet should be provided with non-magnetic stops for the plunger at both ends of its travel. The plunger should be attached to a spring so adjusted that the plunger is held against one stop when the current does not exceed 18 amp and is drawn against the other stop when the current approaches 26 amp.

At what speed must a 900-r.p.m., 5-hp, 250-volt, direct-current, compound-wound motor be driven to produce 50 volts. What current can be obtained at this voltage?
W. H. B.

A 250-volt direct-current motor having a normal speed of 950 r.p.m. would deliver approximately 250 volts if operated as a generator at this speed. A 5-hp motor of this type could deliver about 20 amp as a direct-current generator. That is to say, it could be used as a 5-kw generator. Assuming that the machine is excited from a separate source, it would have to be driven at one-fifth the normal speed of 950 r.p.m. in order to deliver 50 volts, quite independent of the amount of current that was delivered. The armature would carry approximately 20 amp independent of the speed, so that at 50 volts only about 1 kw could be obtained from the armature. Moreover, the machine could not be rendered self-exciting at this emf unless enormous changes were made in the field circuit. If you contemplate utilizing the machine to deliver 50 volts, it would be better to disconnect its armature windings from the commutator segments and reconnect them by the parallel method in order to produce a lower voltage, and then reconnect the individual field coils so that they will receive approximately normal current when subjected to the lower voltage. If these changes are properly made, the machine will deliver approximately its full rated output of from 5 hp to 5 kw.

For determining so-called "earth potentials" in telegraph systems, a common method is to insert a voltmeter in a line grounded at each of the points between which the potential difference is to be observed. The writer believes that a better method would be to insert an ammeter in the circuit joining the two points and calculate the potential by multiplying the ammeter reading by the resistance of the line. Which method gives the more nearly exact result?
A. C. O.

Assuming that the difference of potential is maintained constant between the two points, this potential difference may be measured over a line of moderate resistance connecting the two points by means of either a high-resistance voltmeter or a low-resistance ammeter. If in comparison with the resistance of the line the voltmeter resistance is extremely large and the ammeter resistance is extremely small, the voltmeter reading will agree accurately with the product of the ammeter reading into the resistance of the line. If the resistance of the line is of some magnitude compared to the resistance of the voltmeter, then the voltmeter reading is smaller than the difference of potential between the two points considered. If the ammeter resistance is of appreciable magnitude in comparison with the resistance of the line, then the product of the resistance of the line by the ammeter reading gives a value which is smaller than the difference of potential between the two points. It will thus be seen that neither of these methods gives an absolutely accurate result. The relative accuracies of the two methods will depend upon the relative resistance of the instruments and the circuit joining the two points.

Central Station
Management, Policies and Commercial Methods

ELECTRIC VEHICLE AT DAYTON.

Two years ago there were but thirty-five electric pleasure vehicles in use in Dayton. To-day 125 cars and a dozen trucks are charged from the lines of the Dayton Lighting Company. The central station has several trucks, operating its own garage. About thirty-five pleasure-car owners have their private rectifier sets. Charging energy is sold at the rate of 6 cents per kw-hr., the minimum for rectifier connection being $5 per month.

A GREAT CENTRAL-STATION OPPORTUNITY.

A pamphlet recently printed by the Electric Storage Battery Company, entitled "A Central-Station Prophecy Fulfilled," after noting how previous predictions relating to the advance of the electric vehicle have been fulfilled, asserts that the year 1912 "will be the biggest year 'electrics' have ever had, far bigger than 1911." A strong plea is made to the central station to get alive to the possibilities for big business and secure the co-operation of vehicle manufacturers to that end.

VEHICLE CONSUMPTION TALLY.

To users of electric vehicles in Chicago the Commonwealth Edison Company is distributing metal dial cards having a pair of movable pointers pivoted over dials corresponding to the two right-hand dials of the ordinary customer's watt-hour-meter. By placing the card pointers in positions corresponding to those of the meter at the beginning of a vehicle charge, and then, when through charging, noting the number of divisions that have been passed over by the meter hands, the number of kilowatt-hours consumed is obtained directly, and this method also obviates the possibility of error such as that to which attempts to read the actual total consumptions recorded before and after charging might be subject.

ONE PLEASURE CAR'S PERFORMANCE.

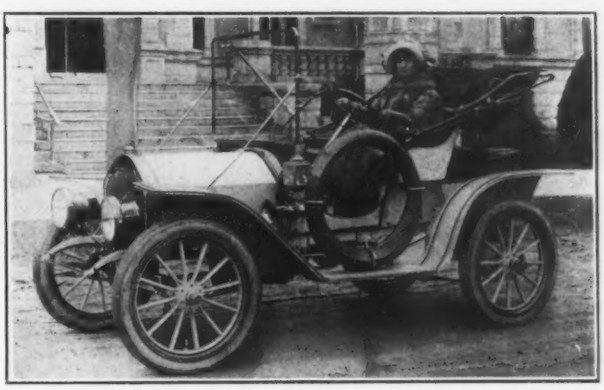
Mr. A. C. Dunn, of Indianapolis, has a forty-cell Woods electric brougham which he permits to be charged only after the car's odometer shows travel approximating 90 to 100 miles. The machine is in daily use as a pleasure car and has made as much as 127 miles on a single charge. In fifteen months the car has run 5300 miles, having been charged but once on an average for each 100 miles traveled. During this time the battery of forty "Exide" cells has never been washed, an inspection of the plates several weeks ago showing but ¼ in. of sediment in the jars. At the end of its 5300-mile performance this car is still rounding out 75 to 85 miles on a single charge, and the attendants at the Merchants' Garage, Indianapolis, where it is stabled, have instructions to charge it only when the odometer register shows mileage approaching this figure.

ELECTRIC VEHICLES IN COLUMBUS, OHIO.

At Columbus, Ohio, a 4-cent net rate for vehicle-charging service has resulted in the use of nearly 500 electric pleasure cars. The central-station company confines this special rate (billed as 5 cents, minus 20 per cent discount, and with a minimum meter charge of 50 cents a month) to vehicle-charging service only, requiring that even garage lamps shall be connected under a separate lighting meter or supplied from the house service. Many owners of electric cars stable their machines in their own private garages, those in alternating-current districts installing rectifiers. All sets of this kind are purchased directly from dealers. Several years ago the Columbus Railway & Light Company operated an electric-vehicle garage, but this was later abandoned. Two local public garages make a specialty of stabling and charging electric vehicles. One company has its charging plugs equipped with watt-hour meters and bills its patrons 6 cents per kw-hr. for the energy actually consumed in charging batteries. The presence of the Columbus Buggy Company in the city has enabled the latter's sales force to concentrate its home efforts on the local situation, with the result, observed in other manufacturers' home cities, that the locally built car predominates in numbers.

A YOUNG LADY ELECTRIC-VEHICLE REPRESENTATIVE AT BOSTON.

One of the unique features of the Boston electric vehicle campaign is the recent entrance of an attractive young lady of some sixteen summers into the agency field, the Babcock pleasure car interests being the possessor of such a representative in the person of Miss Virginia E. Aiken, of Brookline. At the recent automobile show Miss Aiken exhibited three cars, including a coupé for town work, a



Sales Representative in Electric Roadster.

long-distance roadster and a business man's roadster, the two latter cars being guaranteed to run from 150 to 100 miles per charge and at maximum speeds as high as 35 miles per hour. Miss Aiken is a niece of President Day Baker, of the Electric Vehicle Club of Boston, and her saleswomanship has attracted much favorable comment in Boston circles.

SOLICITING WITH ELECTRIC VEHICLE.

For two seasons the Citizens' Light & Power Company, of Adrian, Mich., has sent out a solicitor equipped with an electric runabout to make house-to-house inspection calls and sell appliances. Both directly and indirectly the results of this practice in Adrian, a city of 11,000 population, have proved most satisfactory according to Mr. H. A. Fee, manager of the company, which has 1000 residence users.

The solicitor introduces himself as a company inspector and is prepared to make free renewals of lamps and electric-iron heating elements. Slight repairs to wiring, switches

and other devices are made at cost of time and material. This assistance is useful in maintaining the standard of the company's service, besides assuring that energy-consuming devices are kept in condition for use. Before the solicitor leaves he endeavors to interest the housewife in other appliances, suggests new uses for electricity in that particular household and obtains hints concerning neighboring non-users who may become consumers. Carrying all necessary lamps and appliances in his electric runabout, the solicitor can make from twenty-five to thirty calls a day and endeavors to reach each residence consumer at intervals of two months. Last season, on a proposition of thirty days' free trial, he placed 150 electric irons. Half of the 1000 residence users in Adrian now have electric irons. Besides the direct profit from the soliciting effort, the company is disposed to think of even greater value the indirect advantage of satisfied customers and properly maintained equipment. Apparatus is restored to use promptly which would probably become discarded because of some slight trouble if the customer were required to bring it into the office for repairs.

ELECTRIC FIRE TRUCK.

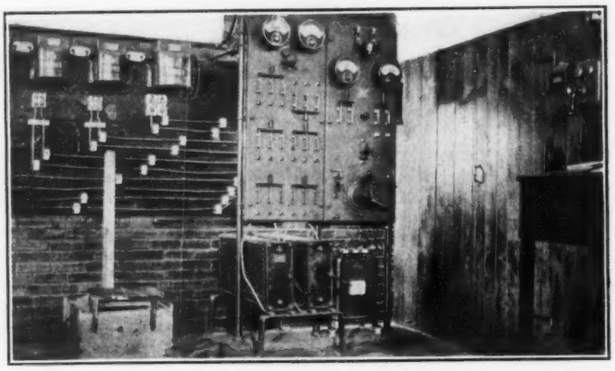
In the issue of Dec. 16 an account was given of some electrically driven fire trucks in Germany. The illustration reproduced herewith shows an electrically driven fire engine adopted by the city of Düsseldorf. A special feature of this truck is the arrangement for attaching a trailer. A storage

Electric Fire Truck.

battery of eighty cells rated at 216 amp-hr. is placed in the hood of the truck, which is driven by two high-speed motors rated at about 15 hp and connected to the front wheels through gearing. The weight of the truck without the trailer but with a hose cart attached is about 7½ tons. The speed is 25 miles an hour at an energy consumption of 85 watt-hours per mile. With a trailer attached it will make a speed of 22 miles an hour at an energy consumption of 95 watt-hours per mile. The running distance is about 62 miles on one charge. Oil or coal is used in the pumping engine, and until the proper steam pressure is reached kerosene is also used, being supplied through an electrically driven compressor. The latter is also used for furnishing air for the smoke masks used by the firemen.

CREATING AN ELECTRIC GARAGE OUT OF A COAL POCKET.

An interesting transformation of a coal pocket to an electric garage was lately made by the Worcester (Mass.) Electric Light Company, in connection with the establishment of an electric-vehicle campaign. The company purchased several electric vehicles for its own use, and in order to give these proper care and to handle commercial charging service a portion of the coal pocket in the old Faraday Street station was cleared, the walls bricked in and charging panels and outlets installed. The garage is open twenty-four hours per day, and at present the company is prepared



Charging Panel in Electric-Vehicle Garage.

to charge nearly a dozen machines simultaneously. Each charging circuit is provided with a watt-hour meter, and energy is furnished through rectifying and motor-generator equipment. The coal pocket was not needed for the storage of fuel after the opening of the company's new turbine station in the southern portion of the city, and the installation has been made at minimum cost.

AN EFFECTIVE ELECTRICAL VEHICLE ADVERTISEMENT.

The Boston Edison Company is doing, as part of its electric-vehicle campaign, some effective publicity work in the daily press. For this purpose large space is taken—quarter-pages and half-pages—and each announcement is devoted to a specific advantage of the electric vehicle, the eye being attracted by well-drawn illustrations. In one advertise-

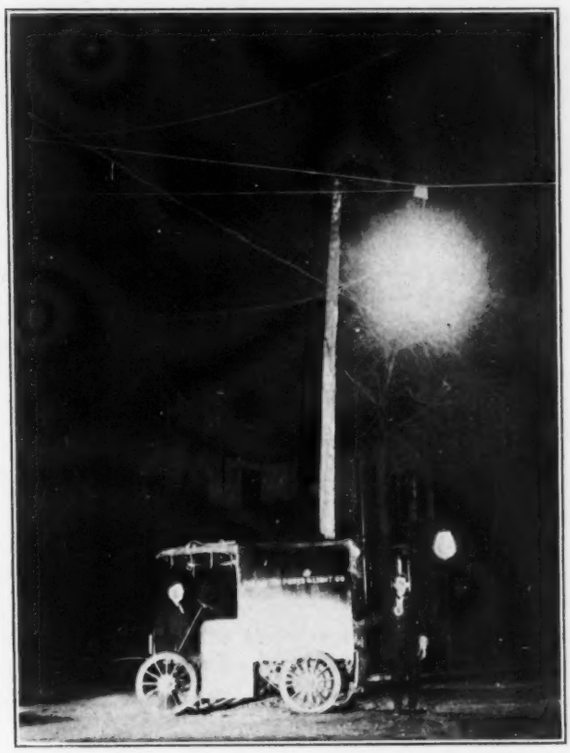
TRUCKING
The Reasons for Its High Cost
Oats Increased 11% in Price in 5 Yrs.
Hay Increased 24% in Price in 5 Yrs.
Corn Increased 16% in Price in 5 Yrs.
Horses Increased 100% in Price in 5 Yrs.
The Electric Truck is the Remedy
It Carries the Load Twice as Far, and at least Twice as Fast as the Horse, greatly reducing the Cost of trucking It's the one answer to street congestion. The Electric Truck lasts 10 years and makes up to 50 miles a day.
While the Price of the Horse and His Food Has Been Climbing
The Price of Electricity in Greater Boston Has Been Falling
Since 1906 modern methods have decreased the maximum price of Electricity in Greater Boston 39%. In the same time the efficiency of the Electric Truck has increased 25%, but the Electric Trucks of 10 years ago are still running. That's a strong endorsement for the better Electrics of today.
The Edison Electric Illuminating Company of Boston

Newspaper Advertisement in Boston Electric-Vehicle Campaign.

ment entitled "Far from the Madding Crowd" an electric pleasure vehicle is shown under a tree, with the mother near by reading and children at play in a field. Another, which is selected for reproduction, presents in pictorial form some strong economic arguments in favor of the electric truck.

STREET LIGHTING FROM ELECTRIC TRUCK.

Trotwood, Ohio, a little city 8 miles north of Dayton, now has electric street lamps, energy for which is transmitted from the plant of the Dayton Lighting Company. The present service was contracted for after an inspection of a sample of electric illumination delivered on one of the principal corners, months before a wire had been stretched



Truck Battery Operating Sample Street Lamp.

in the town. When the contract department of the Dayton company learned that the Trotwood people were interested in electric street lighting, a demonstration was planned to show them exactly how the proposed illumination would look.

A standard 60-cp, 75-watt series tungsten lamp had been hung from a corner span beforehand, and on the evening of the demonstration several company representatives and officials drove over to Trotwood in the contract department's 700-lb. electric truck. Arriving there, the street lamp was connected to the vehicle battery through a rheostat adjusted for the required 6.6 amp. After this demonstration there was a town meeting with addresses by local dignitaries and their electrical guests. In short, the company received a twenty-five year franchise, a ten-year street-lighting contract and a pumping contract. The picture shows the battery-fed electric lamp and one of the old oil lamps which formerly illuminated Trotwood's streets.

ENCOURAGING THE USE OF ELECTRIC VEHICLES.

Prospective users of electric vehicles are greatly interested, naturally, in the actual operating costs of the cars. A considerable collection of data on this subject has been put out, most of it compiled by manufacturers. Prospective customers will be particularly impressed with the actual experiences of other users, and, as hundreds of electric-service companies throughout the United States are users of electric vehicles, opportunity exists for concerted action in collecting exact and authentic information at first hand about the costs of operating electric vehicles under actual service conditions.

Mr. Charles E. Michel, manager of the automobile department of the Union Electric Light & Power Company, of St. Louis, has paid a great deal of attention to the problems connected with the introduction of the electric vehicle by central-station companies. Hs is firmly convinced that an opportunity exists for central-station companies to collect information relating to operating cost of batteries, tires, repairs, etc., entered on a standard form of blank to be agreed upon. The results obtained from a number of the largest cities in the country would be comparable, and it would be possible to make an average which could be presented to prospective customers as authentic and the result of actual experience.

Electric-service companies should be anxious to encourage the introduction of the electric vehicle, for its use and successful operation are important factors in making an increased market for their product. Their greatest interest begins after the vehicle has been sold to the user. Therefore, as they hope to maintain satisfactory relations with the user of the vehicle for a long time to come, they should take pains to be accurate in collecting figures of operating cost, so that these figures may be used with confidence as to their reliability.

With figures of actual operating cost prepared by the electric-service men themselves, and not by the manufacturers, the vehicle salesmen, who are in need of authentic data, will be fortified with strong arguments. If a number of the largest central-station companies throughout the country would agree on a standard form on which to enter the figures, it would not be difficult to gather the information needed. The monthly figures could be combined at the end of the year and general averages established for different classes of vehicles. The results would be incontrovertible, based on the figures certified by representative officers of the large electric-service companies. There would be no question of over-zealousness on the part of electric-vehicle salesmen.

Mr. Michel suggests that central-station forms for keeping electric-vehicle operating costs should be made as simple as possible. Perhaps they might be reduced to the expense of maintaining tires, maintenance of batteries and general upkeep on the remainder of the wagon. With these should be given days in operation and the number of days of idleness due to the fault of the wagon. The monthly mileage should be entered, and if possible the weights carried by commercial wagons, so that a ton-mileage unit could be reached.

ELECTRIC TRUCKS IN DETROIT.

One hundred and twenty-five electric trucks are now in service in Detroit, ranging in size from 750-lb. delivery wagons to 5-ton commercial cars. Contrasted with the present showing, there were two years ago only five battery-driven trucks in the city. This rapid increase has been due, among other causes, to the active efforts of the local central-station company in introducing commercial cars, its low rates for energy for charging, the presence of several electric-automobile manufacturers in Detroit and the excellent paved and level streets of that city.

More than a year ago, to stimulate local interest in commercial vehicles, an Electric Truck Company was organized among officials of the Edison Illuminating Company of Detroit, with Mr. J. W. Brennan, purchasing agent of the company, as manager. This truck company acts as agent for Walker and General Vehicle trucks and maintains a well-equipped garage with a capacity of 35 cars. Besides its own sales efforts, the truck company co-operates with other manufacturers and agents. The Detroit Electric, General Motors, Hupp-Yeats and M. & P. electric com-

mercial cars are all built in Detroit and have aided in the local campaign. The Detroit Edison Company has contributed the services of its salesmen. Practically no advertising has been attempted, personal solicitation being relied upon. From a compilation of central-station battery-charging rates recently made by the electric-vehicle association, Detroit appears to offer rates about as low as any company in the country. Truck owners with private garages can purchase energy at from 4 cents per kw-hr. (less 5 per cent) down to 1 cent, depending on the quantity used. Public garages earn a 3-cent rate, with a discount. Most of the trucks in use in Detroit are of 2 tons rating. Such wagons average a monthly income of $18 each to the electric company when charged in their owners' stables.

The Stroh Brewing Company is among the large local users of electric wagons. Its present fleet of six includes a nine-year-old "Vehicle Equipment" truck, one of the first cars built, and still in active use. The Brewing Company experimented with gasoline cars, but was forced to abandon these on account of their lack of reliability. Duplicating the experience of New York brewers, brewing interests elsewhere are becoming fixed electric-truck users.

Three 5-ton trucks are used by the Mercier Coal Company, of Detroit. These wagons each average 42 miles of travel daily and deliver a total of about 35 tons of coal per day.

An unusual use of electric wagons is the local newspaper distribution service of the Detroit *News*. This company has four 1½-ton, four 1-ton and one 1000-lb. Anderson-Detroit trucks in use, making deliveries of its papers to downtown street corners and adjacent distributing points. For long runs to the outskirts of the city several gasoline trucks are employed, but electricity has succeeded gasoline for all except the most scattered distribution. In downtown delivering the gasoline cars proved unreliable and gave trouble from breaking down. The electric wagons can be absolutely depended upon to make their schedules, and although their speed limit does not equal the gas cars', they accomplish their work with all possible dispatch, making frequent stops in the congested business section.

OPERATING COST DATA OF ELECTRIC VEHICLES.

INFLUENCE OF PROPER TIRE EQUIPMENT.

The effect of proper tire equipment on the efficiency of electric vehicles is of the greatest importance, said Mr. S. H. Conkey, of Minneapolis, in an address before the Minnesota Electrical Association, March 22. Differences of 30 to 70 per cent in car performance have been observed between heavy tires and the best electric-car rubber treads. This means that with suitable tires an electric pleasure car may double its mileage, and the life of its battery will probably be increased in about the same proportion, provided, of course, the car receives proper attention otherwise. This question of tires alone will often account for widely different energy consumptions between two customers having the same make of car and doing approximately the same work.

From reliable data covering operating expenses over a period of three years, the speaker quoted the following figures on 1-ton and 1½-ton wagons: Average days in service per month, 24½; average miles per day per wagon, 29½; average kilowatt-hours per mile, 0.491. Car operating expense per mile: Oil and other supplies, 6 cents; general repairs, 1.4 cents; electric energy, at 4 cents per kw-hr., 2 cents; tires, 1.62 cents; batteries, 1.7 cents; total expense per mile, 7.32 cents.

MAINTENANCE AND OPERATING COSTS.

At the recent anniversary dinner of the electric-vehicle interests of Boston celebrating the close of the first twelve months of the campaign inaugurated by the Edison Electric Illuminating Company in February, 1911, Mr. P. D. Wagoner, president of the General Vehicle Company, delivered an address on "The Electric Vehicle for Trucking and Delivery." Mr. Wagoner emphasized the great volume of sales which has been made in the commercial-vehicle field, stating that in January, 1912, a single manufacturer took orders exceeding those of January, 1911, by 242 per cent. One hundred firms use 1009 trucks of one make, two express companies have purchased 356 trucks, three brewers 172, three packers 119, three delivery contractors 93, and three central stations 158. In some cases trucks have been tried from five to eight years before the purchaser has decided to get rid of his horses. The exact efficiency of the truck in any situation is now largely a matter of detail. Moderate speed is an important factor in operating economy.

Speaking of the life and low cost of a 2000-lb. truck placed in service in Boston in 1906, Mr. Wagoner said that this equipment, belonging to the American Tool & Machine Company, had been maintained and overhauled for a total expense of less than $375 per year, with a daily run of 45 miles for 1650 working days. The high cost of chauffeurs for gasoline truck service was emphasized, together with the high rate of depreciation encountered. The wholesale price of gasoline has increased 70 per cent in the past six months, and a retail price of 25 cents per gallon is not unlikely during the present year. Meanwhile the price of electricity decreases. With forty-eight hours' competent instruction the average teamster can learn to operate an electric truck. A 5-ton electric truck usually requires but one man, compared with the frequent service of two men on 5-ton gasoline trucks. The saving in ground rents by the electric truck is very striking. Standardization of design is a desirable feature in the advance of the industry.

COMPARATIVE COSTS OF OPERATING ELECTRIC, GASOLINE AND HORSE-DRAWN TRUCKS.

In the course of an eight-month test to compare the operating cost of a 1-ton electric truck with its equivalent in horse-drawn wagons, the ton-mile expenses of the commercial cars proved to be just about 75 per cent of those for the animal traction. The two-horse wagons were required to perform the same service as the 1-ton truck, and both vehicles traveled 25 miles on each of the 215 days the test was in force. The figures in Table I give the cost of this service for the electric truck and for the horse-drawn wagons, 26,875 ton-miles being performed in each case.

TABLE I.—COMPARATIVE COST OF ELECTRIC TRUCKS AND HORSE-DRAWN WAGONS.

Electric truck:	
Charge per day, 22 kw-hr. at 4 cents, 88 cents.	
Kw-hr. per mile, 81 cents.	
Charging for 215 days	$189.50
Mechanical and electrical repairs	387.85
Labor on repairs, 11 days at $4 per day	44.00
Tire repairs	71.00
Driver's salary, 8 months at $65 per month	520.00
Depreciation, 10 per cent on $2,800	280.00
Interest, taxes and insurance, 7 per cent	196.00
Garage rent, $5 per month	60.00
Total	$1,748.35
Cost per ton-mile	6.5 cents
Two two-horse wagons:	
Oats per day, 48 quarts at 2 cents, 96 cents.	
Hay per day, 80 lbs. at 6 cents, 48 cents.	
Feed for 8 months' work	$362.80
Feed for 4 months idle at 50 per cent working quantity	172.80
Depreciation of horses, 10 per cent on $800	80.00
Stabling, veterinary, stable man, etc.	240.00
Shoeing	72.00
Depreciation of wagons, 7 per cent on $500	35.00
Depreciation of harness, 10 per cent on $150	15.00
Repairs on harness	10.00
Repairs and paint on wagons	50.00
Wagon storage, per year	125.00
Interest, taxes and insurance on $1,450	101.50
Two drives at $65 per month	1,040.00
Total cost	$2,289.10
Cost per ton-mile	8.5 cents

A set of interesting figures on the comparative cost of haulage service with electric trucks, gasoline cars and equivalent horse-drawn wagons has been prepared by the Waverley Company, Indianapolis, Ind., with special reference to its 1-ton truck. The results of this investigation were obtained from a study of five years' service for each

TABLE II.—COMPARATIVE OPERATION AND MAINTENANCE COST.

	Five Years.	One Year.	One Month.	One Day.
Horse-drawn vehicle equivalent to 1-ton truck:				
Feed and livery	$6000.00	$1200.00	$100.00	$4.00
Mechanical repairs	240.00	48.00	4.00	.16
Miscellaneous, including depreciation, painting, harness and interest	1870.00	374.03	31.17	1.25
	$8110.00	$1622.03	$135.17	$5.41
1-ton gasoline truck:				
Gasoline and oil	$1537.50	$307.50	$25.62	$1.03
Repairs and replacements	2600.00	520.00	43.33	1.73
Tires	770.00	154.00	12.83	.51
Miscellaneous	1474.50	294.90	24.57	.98
	$6382.00	$1276.40	$106.35	$4.25
1-ton Waverley Electric:				
Energy	$822.94	$164.58	$13.72	$0.55
Battery	1445.00	289.00	24.08	.96
Mechanical and tires	1127.22	225.44	18.78	.75
Miscellaneous	1046.69	209.34	17.44	.70
	$4441.85	$888.36	$74.02	$2.96

of the three forms of motive power, the figures being reduced for convenience to equivalent values for one year's, one month's and one day's operation.

Addressing a meeting of managers and secretaries of a group of electric-service companies in Chicago not long ago, Mr. J. A. Cleveland, general manager of the Saginaw (Mich.) Power Company, told of the electric-vehicle experience of the Saginaw companies with which he is connected. Mr. Cleveland, in a carefully written paper, ex-

TABLE III.—COMPARISON OF COST OF OPERATION OF ELECTRIC TRUCK AND OF HORSE AND WAGON.

	Automobile Truck.	Horse and Wagon.
Total number of miles traveled	2,009	2,009
Average number of miles traveled per hour	10.08	4.00
Total number hours traveling	199.4	502.5
Total number hours in traveling and working	846.0	1,149.1
Number hours actually working	646.6	646.6
Total number of days in traveling and working	94.0	127.7
Average number of men employed per hour	3.88	3.88
Equivalent number hours per man traveling	773.7	1,949.7
Labor—30 cents per man per hour	$232.11	$584.91
Maintenance Cost:		
Charging battery—768 kw-hr. at 5 cents	$38.40	
Estimated amount charged for battery renewals and repairs	63.00	
Estimated amount charged for mechanical repairs	18.00	
Estimated amount charged for tire renewals and repairs	30.00	
	$149.40	
Estimated amount at 8.5 cents per hour of service.		$97.69
Total cost of doing work	$381.51	$682.60
Operating cost per month on above basis	105.98	189.61
Operating cost per year on above basis	1,271.76	2,275.32
Fixed Charges:		
Interest—5 per cent of $1,800	$90.00	
Depreciation—10 per cent of $1,800	180.00	
	$270.00	
Interest—5 per cent of $375		$18.75
Depreciation—15 per cent of $375		56.25
		$75.00
Total cost per year	$1,541.76	$2,350.32
Saving per year with electric truck, $808.56.		

pressed the belief that the electric automobile presents to the central stations a great opportunity to secure profitable business. The business is off-peak, improves the load-factor, and the consumption of energy by each vehicle is from 1500 kw-hr. to 12,000 kw-hr. per annum. In Saginaw careful records have been kept of two electric trucks purchased from the Argo Electric Vehicle Company, of that city. One, a 1000-lb. wagon, is used by the gas company as a meter and service truck; the other, rated to carry 2000 lb., is used by the Saginaw Power Company in line and repair work. The figures in Table III are based on the operation of the smaller truck from June 12 to Sept. 30, 1911, compared with the actual cost of doing the same work by means of a horse and wagon.

COST PER CAR-MILE.

All told, the Comonwealth Edison Company of Chicago has forty-three electric vehicles in service. In addition, it has twenty-five electric delivery wagons on order, and these will be added to the "fleet" very soon. Then the company will have a total of sixty-eight electric vehicles in operation. Of the forty-three vehicles now in use, thirty-one have a carrying capacity of 3000 lb. There are also two wagons of 700 lb. carrying capacity, four of 1500 lb. and four of 2000 lb. In addition, there are one 5-ton truck and one 3½-ton truck which are used for hauling heavy reels of cable and heavy machinery.

Excluding the two very large trucks and eleven of the wagons which have been in service for a number of years, there remain thirty which are of modern type, and of these newer vehicles twenty-eight were in daily service during the month of December last. The Commonwealth company's electric wagons are used for delivering supplies, for making lamp renewals, in the work of meter installation, in overhead-line work, and in the pulling-in of cables, as well as the hauling of cables by the heavy trucks. For several years the company has kept very careful records of the cost of operating its electric wagons, and it discontinued the purchase of horses entirely some time ago, being satisfied of the superior economy of the electric vehicle.

For a period of three years, ended Dec. 31, 1911, considering the thirty modern vehicles (of which twenty were 3000-lb. trucks, four 2000-lb. wagons, four 1500-lb. vehicles and two 700-lb. cars), an elaborate tabulation has been made showing the cost of operation month by month. The grand total of the average cost per car in service per month was $194.91, and the average cost per car-mile was 25.2 cents. This includes the driver's salary and interest charges of every description. Detailed averages made up from the monthly figures of the modern cars actually in service for a period of thirty-six months are as follows:

Average per month for each vehicle: Oil and other supplies, $5.16; energy at 4 cents per kw-hr., $15.36; general repairs, $13.44; tire expense, $8.91; battery expense, $9.93; total operating expense, $52.80; general expense, including supervision, wheel tax, state license and casualty insurance, $16.47; driver's wages, washing, oiling, minor repairs and garage operating expense, $89.02; fixed charges, including interest at 6 per cent, taxes at 1.5 per cent, insurance at 2 per cent and depreciation at 10 per cent, $30.72; additional fixed charges on garage, land and buildings, $5.90; grand total of the average cost per car in service per month, $194.91.

Average cost per car-mile: Oil and other supplies, 0.7 cent; energy at 4 cents per kw-hr., 2 cents; general repairs, 1.7 cents; tire expense, 1.1 cents; battery expense, 1.3 cents; total operating expense per car-mile, 6.8 cents; general expense, including supervision, wheel tax, state license and casualty insurance, 2.1 cents; driver's wages, washing, oiling, minor repairs and garage operating expense, 11.5 cents; fixed charges, including interest at 6 per cent, taxes at 1.5 per cent, insurance at 2 per cent and depreciation at 10 per cent, 4 cents; additional fixed charges on garage, land and buildings, 0.8 cent; grand total average cost per car-mile, 25.2 cents.

The average number of miles traveled per vehicle per month for the three-year period was 775, and the average consumption per mile was 0.495 kw-hr. The average miles per day of wagon in service was 30.5 and the average days in service per wagon per month was 22.6.

TRADE RELATIONS IN THE ELECTRICAL INDUSTRY.

By Philip S. Dodd.

The question of trade relations between the central station, the jobber, the contractor and the manufacturer has been for many years much debated. While some relation along co-operative lines has been recognized as a vital necessity to the growth of the electrical industry, the point for debate has always been as to just what this co-operation could be and just what lines it should follow. It is recognized that the central stations must to a certain extent take the initiative because of the fact that it is their energy which will be used for the operation of all current-consuming devices sold. There are so many points to be considered and local conditions vary so greatly that the question of co-operation along any line must naturally be a question to be discussed locally rather than as a national proposition. Either locally or nationally the solution can logically be arrived at satisfactorily from only one viewpoint, "the greatest good to the greatest number," and the "greatest number" means not only the manufacturers, the central station and other distributers of energy and devices but the public as a whole, the ultimate consumer of electrical energy and electrical products.

Admitting that the use of electrical energy through some form of current-consuming devices confers a benefit on the vast majority of the individuals who go to make up our population, the question is how best to increase the uses of electricity and educate the masses to a fuller knowledge of the benefit that lies at their hands. Considering the question from the viewpoint of industrial economies, it would seem that this education could be best handled through co-operative effort on the part of the various interests which are endeavoring to increase the sale of current-consuming devices or electrical energy, and as it is clear that co-operation is only possible where all have equal opportunity for profit in proportion to investment or effort expended, it would appear necessary that the first step toward any practical move for development should be harmonization of the various allied, but sometimes warring, interests. Agreements must be reached and adhered to as to the definite field of operation of each and arrangements made which will give to each a fair return and an equal opportunity. Once this is accomplished, the means for development of the market are many.

To the initiated electricity is a simple servant, easy to handle and control, and always ready for work at a pull of the switch or a pressure of the button, but it must be remembered that to the great majority of the public it has been a thing of fear, a stupendous mystery, and that increase in its use must come through education—education along the lines of safety, economy, healthfulness, readiness and sureness of service and the like.

Education is more vital to the increased use of electricity than to the marketing of any other commodity which is in general use by the public to-day. Efforts toward that education are being made in many directions and in many different ways—through publicity work on the part of the various local organizations, such as the Jovian luncheon clubs, luncheon club branches of the National Electric Light Association company sections, development leagues, etc., and the effort that is being made by them in every progressive city where it has not already been started to publish co-operatively an "electrical page" in the newspapers; by co-operation with boards of trade and chambers of commerce to advertise and assist in the development of the city itself by the use of electric signs, improved street lighting, etc., and in several cases where it has been successfully demonstrated that it is possible to arrange with school boards for the introduction of electrical courses in the schools and colleges.

The Commercial Section of the National Electric Light Association is doing a number of practical things for the development of the industry through the preparation and distribution by some of its committees of publications of educational value covering the wiring and lighting of homes, the lighting of factories and workshops, the lighting of streets, sign lighting, etc., and by the dissemination among its members for use in their work with the public of information pertaining to commercial practical selling methods, data relative to current-consuming devices, power data, etc. Its further plans include a cumulative index of the above, together with a complete catalogue of current-consuming devices and properly indexed digests or abstracts of articles of commercial interest appearing in the current technical papers.

All this work, which is co-operative, not only on the part of the operating companies but between them and the manufacturers, the jobbers and contractors, is affecting the entire industry and is gradually but surely bringing about more harmonious relations among the different interests and settling day by day the question of trade relations which until only recently has stunted the growth of the business.

We are all learning—the central station that real development comes only by the use of intelligent effort in educating the public and by active co-operation with the jobbers, contractors and manufacturers, and the jobber, contractor and manufacturer that it is not only desirable but necessary that they co-operate with and secure the full co-operation of the central station.

The N. E. L. A. Commercial Section, the jobbers and contractors' associations, the Jovian order as a whole and through its local organizations, and the various other local organizations, are all working co-operatively among themselves and in many instances with each other toward practical concatenated effort for the development and betterment of the business as a whole; and while individual publicity is logical and valuable and will without doubt always be continued, the tendency is toward mutual effort for mutual good, not only among publicity lines but in many other channels. The time is not far distant when this working together of the various interests will settle quietly and naturally the differences which may appear great to us all to-day.

The tendency of the times is for "getting together" and toward organized, rather than individual, effort in development work, so that the question of "Why should I join the Jovian order, or the National Electric Light Association?" is beginning to put itself into the class called "foolish." Two heads are better than one and 10,000 heads are better than two. No one man can afford to lose the opportunity for the securing of information such as the committees of the Commercial Section of the National Electric Light Association are disseminating, which has a direct bearing on problems confronting the commercial men of to-day, nor the harmonious relations with his follow-men and practical help offered by membership in the Jovian order.

All together, all the time, for everything electrical, is coming to mean more and more each day to all of us, for though there are not many of the mighty, the many are mighty.

"THE POWER BEHIND MINNEAPOLIS."

"The Power Behind Minneapolis" is the title of an attractive booklet of pictures of its power plants and system recently issued by the Minneapolis General Electric Company for public distribution. The purpose of the publication is best stated in the preface in a series of questions: "Do you know the power behind the lights of Minneapolis? Do you know where this power comes from, the capital invested in producing it and the men and machines busy night

and day to supply it? Do you know just why Minneapolis has a right to be proud of this great public servant, how plans are made years ahead so that the city's growth will not be retarded, and of the steady decrease in the cost of this great necessity? . . . This booklet answers these questions and many more in the fewest possible words." Besides illustrations and brief data concerning each of the company's stations, the schedule of rates for electric service is included in the pages of the booklet.

Wiring and Illumination

NEW SYSTEM OF BOARDWALK LIGHTING AT ATLANTIC CITY.

There has just been installed on the Boardwalk at Atlantic City, N. J., a new system of lighting which will displace the present festoons so well known to visitors at the famous seaside resort. Part of the system will be placed in operation for the first time on Easter, and shortly thereafter the walk will be cleared of all overhead lines and festoons and the poles with their transformers and all else appertaining to the usual overhead pole-line construction will be no more seen. The city has spent $35,000 to bring about the change and the Atlantic City Electric Company has spent fully $25,000 additional in placing its distribution system under the Boardwalk and making the necessary extensions.

The new system of lighting extends for 3½ miles, and there are approximately one twin arc post and five intermediate posts to each block. The twin arc post is located

Fig. 1—New System of Boardwalk Lighting at Atlantic City.

at the outer edge of the walk at street intersections and is shown in Fig. 2. It is 23 ft. 8 in. high, and 13 ft. 3 in. above the walk are brackets for incandescent lamps. After trying various types of arc lamps on the posts it was finally decided to adopt the 6.6-amp inclosed arc inasmuch as this blended best with the tungstens and did not give excessive glare. The intermediate posts are 18 ft. 8⅜ in. high and each contains a 150-watt tungsten in the upper 24-in. milk globe, while lower down on the posts are brackets holding four 60-watt tungstens in smaller globes.

The posts themselves are of ornate design built by the J. L. Mott Iron Works. The bases are designed to serve

Fig. 2—Twin-Arc Post at Street Intersection.

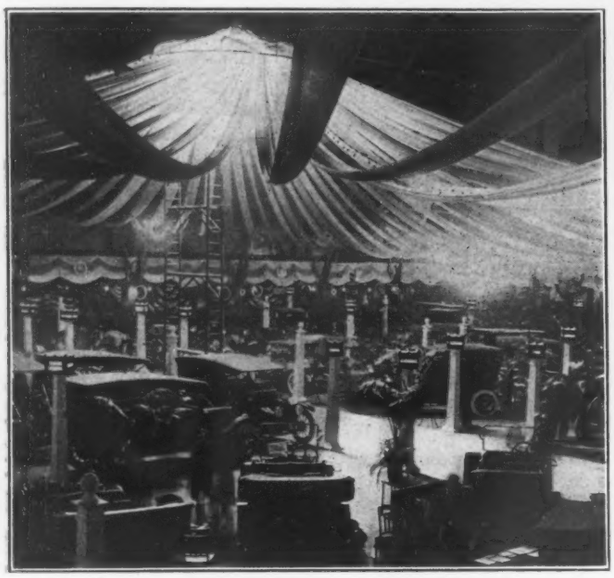
as supports for the outer railing of the Boardwalk and connection is made with the galvanized-iron conduit system under the walk through cast-iron junction and service boxes specially designed for the system at Atlantic City. The boxes are fastened to the walkway beams and the lamps are controlled on the block system; that is, the lamps for from two to three blocks are connected to a single cut-out and placed in circuit by means of a switch in the service box under the walk. Alternating-current lines under the walk receive energy from transformers placed in concrete transformer houses under the walk or from transformers on overhead poles located on the side streets. Where head room was available under the walk concrete receptacles large enough to house three 100-kw transformers were built, but where head room was not available poles were erected on the side street about 50 ft. back from the Boardwalk on which the transformers are mounted. A four-wire, three-phase, 2300-volt system of distribution is used with grounded neutral.

While festoons will not be used for the present, the scheme provides for them should they be required in the future. In such case intermediate posts will be erected on the street intersection on the inner side of the Boardwalk, just as they are at present in front of the Marlborough-Blenheim. The festoons will then be looped from post to post along the outer edge of the walk and from post to building across the walk or to intermediate posts where buildings are not available. It is hoped to use 5-watt tungsten lamps in the festoons when they are finally installed. Mr. L. W. Byers is the general manager of the Atlantic City Electric Company and to him is due much of the credit for the new system. The festoon system at present in use was intended for temporary use when installed, but was so well spoken of that it was kept in service for over seven years despite its frail construction.

ILLUMINATION OF BALTIMORE AUTOMOBILE SHOW.

The lighting of the automobile show recently held in the Fifth Regiment Armory, Baltimore, Md., was carried out by methods both effective and unique. In the center of the building 40 ft. from the floor hung the main illuminating unit, consisting of a cluster of 406 100-watt frosted-bowl tungsten lamps and one 500-watt frosted bowl. These were arranged on a hemisphere 9 ft. in diameter and suspended at the focus of a diffusing reflector 20 ft. in diameter. The reflector was formed by stretching white canvas upon a suitably shaped frame. This unit was in effect a 40,000-watt frosted lamp with reflector, effectively illuminating over half the entire floor space of 60,000 sq. ft.

From the rim of this shade to the walls were draped streamers of white and pale green bunting, which formed a false ceiling, directly under which were hung nearly 1000 25-watt tungsten lamps, extending radially from within about 50 ft. of the center to the sides and ends of the building. In each of the four corners were erected ornamental torchères about 15 ft. high, each carrying eleven 500-watt frosted tungsten lamps, delivering altogether about 16,000 cp.



Illumination of Baltimore Automobile Show.

The enormous amount of light combined with the good reflecting surface and diffused by the use mainly of frosted lamps produced a soft light approaching the brilliancy of daylight, making unnecessary any individual exhibit or sign lighting. Nearly 2000 lamps were used, with a total rating of 120 kw and delivering approximately 80,000 cp. Over 20 hp in small motors was used by the different exhibitors.

ELECTRIC-TRUCK LINE REPAIR WAGONS.

The Dayton Lighting Company makes use of four battery-driven commercial vehicles—a 700-lb. wagon for maintaining the city street arcs, a 1000-lb. truck for customers' services, a 2000-lb. truck for heavy construction work, and a 700-lb. office delivery wagon. These trucks displaced a stable of seven horses, and easily accomplish far more work in less time than the former horse-drawn wagons. Sometimes the repair wagons are required to make successive trips to opposite sides of the city. Two such widely separated calls used to be a day's work for the horses, but, by reason of the greater speed and endurance of the electric vehicles, these cars can return in time for half a dozen calls around town before the close of the day.

One of the line wagons is equipped with a searchlamp fed from the truck battery, as shown in the illustration. This equipment proves its value after dark, when emergency work is to be done on poles or transformers. The truck is run alongside and its beam directed at the pole top, enabling the lineman to make his connections as conveniently as in daylight. The arc repair wagon is fitted with an attachment plug in one of its lamp sockets, which is used to test arc lamps for grounds, crosses, etc. An incandescent lamp is cut in series with the test wires to limit the flow of battery current. Lamp outages are reported by the police, and when the faulty lamp is inspected next day, although it may appear to be mechanically operative, this simple test quickly shows whether any parts are electrically grounded.

Searchlamp in Service on Edison Line Wagon.

LIGHTING OF ELECTRIC VEHICLES.

The greater part of the electric vehicles at present in use are equipped with batteries having twenty-four, twenty-six, twenty-eight, thirty, thirty-eight, forty and forty-two lead cells or forty and sixty nickel-iron cells. It is evident, therefore, that the wiring of lamps for electric vehicles must vary with the make. One practice that is followed by practically all makers on at least some of their cars is to wire the lamps across the entire battery, so that they will burn at the total battery voltage. The voltage of the circuits will depend, of course, upon the number of cells in the battery and upon the wiring scheme. Ordinarily voltages ranging from 24 volts, in the small pleasure cars, up to 90 volts, in some of the larger electric trucks, are available.

The lamps in the side and head lanterns are wired in multiple, and the lamps in the tail and meter lanterns are usually wired likewise. Some makers wire the tail and meter lamps in series, inasmuch as this method gives a continuous light on the meter and also affords a ready

means of determining if the tail lamp is burning. Side lamps and head lamps are almost always controlled separately, and some makers of electric vehicles even go so far as to provide a separate switch for each lamp. Thus, when the car is at the curb, one side lamp on the traffic side

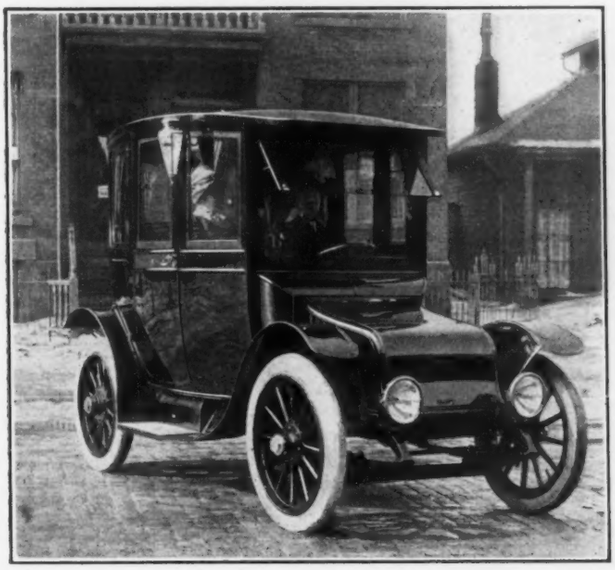


Fig. 1—Electric Vehicle, Showing Side Lamps Placed High.

can be left in circuit while the rest of the lamps are extinguished.

The usual equipment for electric vehicles comprises two side lamps, one or two head lamps, a tail lamp and a meter lamp, and in some cases a dome lamp within. Fig. 1 shows a well-known make of pleasure vehicle with the side lanterns placed high. Two head lanterns are used on this type of car and are fitted with parabolic reflectors and close-coil carbon-filament lamps. In many makes of cars the side lanterns are placed lower down on the body, and in not a few each lamp is controlled independently by a switch near the controller lever, the meter lamp being placed in circuit by means of a foot button. Fig. 2 shows a number of electric delivery cars in Cleveland. These have but one head lantern, which, as shown, is placed low in front and mounted directly on the chassis. As the tail lantern is also

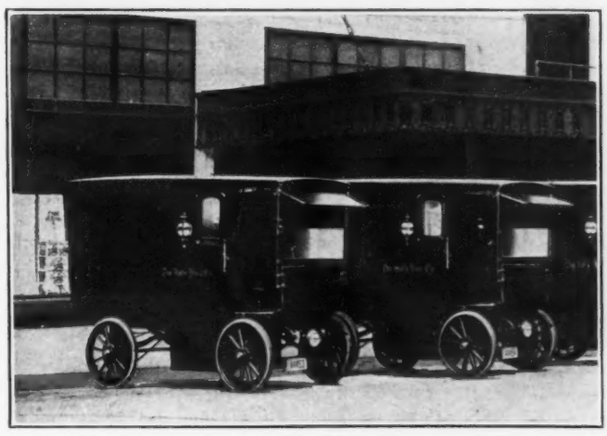


Fig. 2—Electric Delivery Cars, Showing Position of the One Headlight.

mounted directly on the chassis, the greater part of the wiring on the car is confined to what might be called its permanent parts. These lanterns are fitted with 8-cp carbon close-coil lamps, which give sufficient light for the class of work in which these cars are engaged.

TESTS ON GAS AND ELECTRIC ILLUMINATION IN AN AUTOMOBILE FACTORY.

By H. H. Magdsick.

In the "E. M. F." automobile factories of the Studebaker corporation at Detroit are two rooms, lighted respectively by gas and electric lamps, which are so similar in every respect that satisfactory comparisons may be made from the results obtained with these two types of lighting equipment. In February, 1911, soon after the units were installed, a comparative test was conducted under the direction of Mr. Frank S. Fugate, illuminating engineer of the Detroit City Gas Company. The factory management was represented by Mr. John A. Beirns. A brief summary of this test appeared in the *Illuminating Engineer* for March, 1911. The full report indicates that it was made with more than usual care and that the results obtained are thoroughly reliable.

In July, 1911, about five months later, a second test of these installations was made by Mr. Ward Harrison, Mr. H. T. Spaulding and the writer, of the engineering department of the National Electric Lamp Association, with the co-operation of Mr. Erne H. Wilsher, chief electrician of the "E. M. F." factories. Previous conditions were duplicated so far as possible; readings were taken in the same

TABLE I.—TEST OF GAS EQUIPMENT.

Unit.....Humphrey three-mantle inverted gas lamp, clear globe, roughed top
Number of units.....46
Units per bay.....2½
Total consumption per unit....11 cu. ft. per hour, measured at 2.2 in.
Pilot consumption per unit.....0.33 cu. ft. per hour, measured at 2.2 in.

	Date of Test.		
	Feb. 13, 1911.	July 7, 1911.	July 7, 1911
Gas pressure in inches.....	2 to 2.2	3 to 3.1	2.2 (Lamps not re-adjusted)
Maximum foot-candles.....	8.00	3.65	....
Minimum foot-candles.....	1.64	0.74	....
Average foot-candles; Stations 1 to 56.....	4.19	2.12	....
Percentage initial intensity.	100.	50.6	....
Average foot-candles; Stations 6, 13, 20, 27, 34, 41, 48 and 55.....	4.60	2.27	1.35
Percentage initial intensity.	100.	49.4	29.4

bays and at the same stations. In the earlier test the Sharp-Millar portable photometer was used, and in the later measurements were made with a Weber instrument of latest design with Lummer-Brodhun contrast screen. This instrument has been found to give exceedingly accurate results in the hands of experienced operators. It was carefully calibrated before and after the test.

The gas lamps were installed in the gear-painting department on the fourth floor. Forty-six three-mantle inverted lamps with roughed-top clear globes were used in the room, which has an area of over 15,000 sq. ft. The supporting columns are of steel shapes, 5 in. by 8 in. The ceiling is covered with white cotton, which had become rather gray with dust at the time of the second test. The greater part of each side is taken up with windows; the remaining parts of the walls are white. The floor is covered with burlap. The gas equipment, a six months' trial installation, was considered a model in every respect. The lamps received careful maintenance service, being cleaned, adjusted and inspected once each week. The last visit of the maintenance man had occurred four days previous to the July test, and an inspection of the units showed the lamps to be apparently in perfect condition. A small hole was found in one mantle of a lamp outside the test area, but with this exception there were no cracked, broken or blackened mantles. The burners were found to be so adjusted that the flames completely filled the mantles. The glassware was free from

dust and dirt. The diffusion of light in this room was good, but, owing to the fact that the lamps were equipped with clear globes and suspended only 9 ft. above the floor, the glare from them was annoying and detracted to some extent from the effectiveness of the illumination.

The electric installation consisted of clusters of four

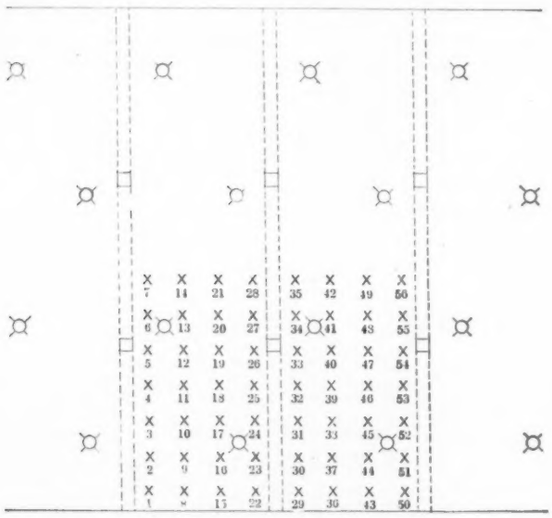


Fig. 1—Arrangement of Gas-Lighting Units and Test Stations.

40-watt tungsten-filament lamps with dome-shaped enameled steel reflectors, which served to keep the lamps out of the usual range of vision. They were installed on the second floor of the building in the body and top-fitting department. Thirty-seven of these units were used in a room with an area of about 7500 sq. ft. The columns on this floor are of reinforced concrete, 16 by 16 in. The walls are similar to the walls on the fourth floor and the ceiling is white. The lamps had been in use at their high-efficiency rating or top voltage for about 1400 hours, and had not been touched except for the purpose of renewing three lamps.

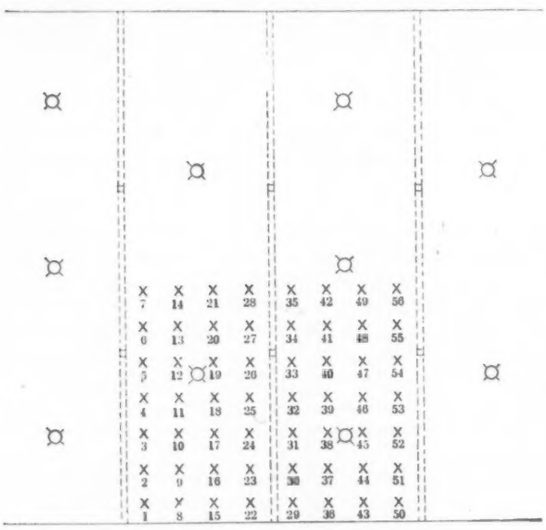


Fig. 2—Arrangement of Electric-Lighting Units and Test Stations.

Absence of glare, uniformity and excellent diffusion characterized the illumination on this floor.

The test areas, location of units and the test stations are shown in Fig. 1 and Fig. 2. In each case the bays had dimensions of 15 ft. 8 in. by 52 ft. 4 in., or an area of 820 sq. ft. The ceiling height was 12 ft., the height of the lighting unit 9 ft. and the height of the test plane 2.5 ft.

Table I gives a summary of the results of the February and July tests on gas lamps. In the latter the readings were taken without changing the adjustment of the lamps. The pressure at the lamps was measured from time to time, and it was found that, whereas at the time of the earlier test the pressure was between 2 in. and 2.2 in., it had been raised to from 3 in. to 3.1 in. Accordingly the gas was throttled to a pressure of 2.2 in. to determine for which pressure the lamps were adjusted. That they had been adjusted for 3 in. became apparent from the fact that the lamps flickered when the pressure was reduced and the illumination was decreased by about 40 per cent, as is shown in the last column of the table.

TABLE II.—TEST OF ELECTRIC EQUIPMENT.

Unit.....American arc-lamp cluster; four 40-watt tungsten-filament lamps, dome-shaped enameled steel reflector
Number of units.....37
Units per bay..... 4

	Date of Test.	
	Feb. 13, 1911.	July 7, 1911.
Condition of units.....	New; clean	Burned 1400 hours; clean
Maximum foot-candles.....	6.20	4.67
Minimum foot-candles.....	2.10	1.66
Average foot-candles:		
Stations 1–56.....	3.87	....
Stations 1–28.....	3.87	....
Stations 29–56.....	3.87	3.18
Percentage of initial intensity...	100.	82.2
Effective lumens per watt.....	4.96	4.08

Candle-power depreciation, 1400 hours burning, 17.8 per cent.

Table II gives the results obtained in the two tests on the electric installation. The units were clean when each set of measurements was made. Voltage readings were taken simultaneously with the illumination measurements and the values of intensity were corrected to the rated voltage of the lamps in each case. The average voltages of the circuit were within 1 per cent of the rating. While only one-half the total number of stations were used in the later test, it will be noted that these are representative of all points and that the inclusion of the remaining stations did not affect the results in the earlier test.

A part of the depreciation in the illumination of both the gas and electrically lighted areas was no doubt due to the increased absorption by the walls and ceiling, which had darkened somewhat since the first test. The gas installation suffered more from this effect since a larger proportion of the light was reflected from the ceiling and walls; however, the depreciation from this cause was relatively small.

To make the results in Table I comparable it is necessary to allow for the fact that the candle-power of the gas lamps was increased with the higher pressure which obtained during the second test. A test on a three-mantle lamp of this type showed that with the unit properly adjusted in each case the candle-power at a pressure of 3.1 in. is 8 per cent higher than at 2.2 in. Hence, if the results obtained in the test of July 7 are corrected by this percentage, we find that the illumination received after the units had been installed for five months was only about 46.8 per cent of the initial value.

It will be noted that the lamps in the electrically lighted room had operated far beyond their rated life and that the candle-power depreciation was therefore greater than under average conditions. In planning the installation in the "E. M. F." factories monthly maintenance service was provided and a charge of $0.45 per cluster per year was made in the estimate of operating cost to cover the expense of cleaning and renewing lamps. In the case of the room under test, however, the units were left untouched during the five months except for the purpose of renewing three lamps, as stated above. Measurements made preliminary to the cleaning of the units showed that the accumulation of dust during this period caused a total loss in illumination of 18 per cent, which is at a rate of less than 4 per cent per

month. This indicates that with a system of monthly maintenance as carried out in this factory the average loss of light due to dust could practically be neglected.

Letters to the Editor

INVENTORS' PROFITS.

To the Editor of Electrical World:

Sir:—As prospective inventors and electrical engineers have repeatedly asked me what chance nowadays exists for profits from inventions, I urged President Coffin of the General Electric Company to make an official statement in this regard. I quote from his answer:

"We have paid in the aggregate many millions of dollars to inventors not in the employ of the company, and we have probably spent in salaries of inventors employed by the company and in taking out and protecting patents based upon their inventions many millions of dollars besides."

Other companies could probably say the same thing.

New York. Edward P. Thompson.

MILWAUKEE "WAYSIDE" TELEPHONE SERVICE.

To the Editor of Electrical World:

Sir:—Recently there appeared under the heading "Wiring Inspectors Make Good Use of Motorcycles" a note containing a good boost for Detroit. Although it is true Detroit has outstripped Milwaukee in population, it is not mere size that counts. The Milwaukee fire and police alarm department not only makes good use of the motorcycle in wire maintenance, but its superintendent, Mr. Oscar D. Kleinsteuber, has developed and is now installing a "wayside" telephone that goes the Detroit "wayside jack connection" considerably more than "one better."

In appearance the box resembles a type of fire-alarm box not uncommon in American cities. The apparatus and door now in use are being transferred to the Kleinsteuber combination box. The front of the box contains the standard apparatus behind a keyless door, and on the right side is the patrol call apparatus and telephone set for the police department. That apparatus, too, is standard, and is being transferred from the police patrol boxes that are being displaced with the new type.

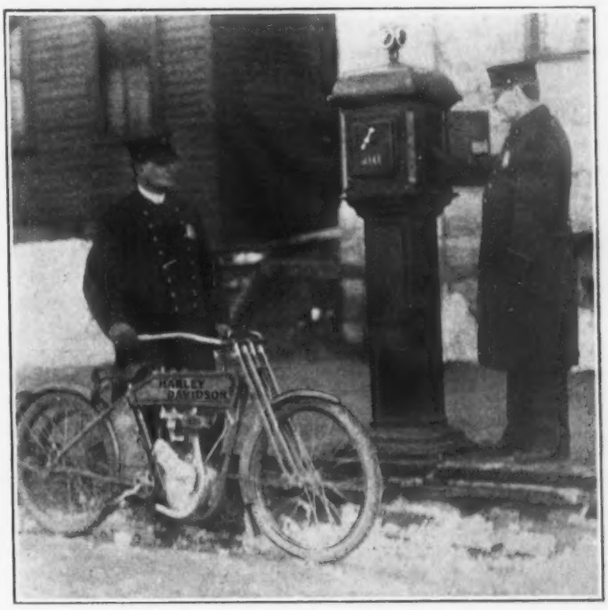
On the left side of the box is the "wayside" telephone for the use of all city departments. Of course, it will not be used ordinarily by the police department, which has its individual wires and separate switchboard owing to the requirements of secrecy. But, if a police department circuit shows trouble, the general municipal telephone can be resorted to in making connection with the police department switchboard through the municipal switchboard in the city hall.

Primarily the municipal telephone system was designed for sanitary inspectors of the health department. Much time was lost by the inspectors because of the lack of ready communication with the health commissioner and the chief of inspectors. To give the health inspectors unlimited use of the police telephones was not considered advisable. Each inspector had a trap key to open police patrol boxes in cases of emergency, but in his routine work had to depend upon private telephones. Saloon telephones were used frequently, impairing discipline.

In addition to health, factory, bakery, milk, building, elevator and street inspectors and employees of other city departments in need of telephonic connection with the city hall, all the public schools, hospitals, public baths, libraries, pumping stations and other public buildings are to be connected with the municipal switchboard in order that there can be inter-communication of departments without going off city lines. Telephone calls with private telephones will be handled over trunk lines connecting the municipal board with the main switchboard of the Wisconsin Telephone Company. The municipal switchboard nearing completion will cost about $2,000.

Each of the 704 fire-alarm boxes is to be replaced with the combination box, giving that number of police patrol boxes and that number of "wayside" telephones. At present there are but 295 police patrol boxes. To combine the fire and police alarm apparatus and to add the wayside telephone at an old location costs but $44.73, of which $40 is for the iron casting, $1.73 for the additional telephone set and $3 for the lamp on the top of the box.

The lamp shows a red light at night in order that fire boxes may be located easily in emergencies. Through an automatic device controlled from police headquarters, any lamp or any number of lamps can be made to flash to show patrolmen they should call up the central operator. The cost of the light will not exceed 2 cents per night. While the lamp is burning the officer on the beat will know the boxes are in service. When the lamp is extinguished attention will be called to the wire trouble. On his motorcycle the trouble man can locate the trouble and make repairs quickly.



Motorcycle Used in Milwaukee for "Wayside" Telephone Inspection and Repairing.

In the old box there was a telegraph key for calling additional apparatus after the first alarm had been sent in with the break wheel. Code call numbers were used, tending toward confusion, in obtaining additional apparatus. With the new box an assistant chief will have a telephone close at hand day or night. For second, third and general alarms he will use the regulation fire-alarm apparatus, but if he wishes only an extra engine or two he can specify his wants over the telephone. With the telephone the chief can call for exactly the amount of apparatus and for the exact number of men he needs at a fire, not decreasing unnecessarily the protection afforded by the men in the houses.

Mr. Kleinsteuber plans to put into service within a few days another motorcycle with free-wheel control, so the linemen can stop at various alarm boxes without stopping the engine. He will also replace a wagon with a motor truck. The city will then sell the last four horses in the fire and police alarm department.

Milwaukee, Wis. Frank B. Rodger.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Current and Power-Factor in Induction Motors.—H. J. S. Heather.—The author first gives a simple theoretical proof of the rule that in an induction motor the power-factor at constant amperes is unaffected by the speed. Two applications are made of this rule. The one is a method of testing the commercial efficiency of slip-ring induction motors. The other is a method of control for hoist motors, which is equal in simplicity to that used in the Ward Leonard arrangement. If an ammeter affords a definite indication of torque at all speeds, as it does, the arrangements for controlling an induction motor winder can be made exactly similar to those used with the Ward Leonard system, and the driver need have nothing to watch during trips beyond the ammeter and his depth indicators. Finally the results are given of tests of winding motors showing the correctness of the above rule.—London *Electrician,* March 15, 1912.

Single-Phase Commutator Motor.—A note on a recent British patent (No. 20,829, March 7, 1912) of the British Thomson-Houston Company (Allgemeine Elektricitäts-Gesellschaft of Germany). The rotor and stator are excited alternately. There are two fixed and two movable brush sets, one of each is connected to the supply and the other to a portion of the stator winding, which is in two parts, the other part being in the axis of the fixed brushes and connected in the motor circuit or short-circuited on itself. At starting the movable brush set is approximately at right angles to the fixed set and is rocked by the switching attachment until both fixed and movable brush sets are coincident at full speed. The brush-shifting mechanism and starting switch are interlocked, so that the brushes can be moved only in direction corresponding to the connections. The effect of the second stator winding is weakened at starting.—London *Elec. Eng'ing.*—March 14, 1912.

Transformer Diagram.—J. Moellinger and H. Gewecke.—The authors give a diagram which can be plotted after a no-load test, a short-circuit test and a resistance measurement, and after an approximate determination of the ratio of transformation. From this diagram the behavior of the transformer at all loads can be easily determined.—*Elek. Zeit.,* March 14, 1912.

Commutation.—F. Niethammer.—A mathematical paper discussing some points in the theory of commutation of direct-current machines, especially the criterion of the formation of sparks and the determination of the reactance voltage.—*Elek. Zeit.,* March 14, 1912.

Lamps and Lighting.

Drawn-Wire Tungsten Lamps.—F. W. Willcox.—A communication commenting on some features of drawn-wire tungsten lamps. The first relates to the performance of the drawn-wire tungsten lamp on alternating current. Statements have been made to the effect that a drawn tungsten wire filament suffers from "offsetting" with reduction of life on alternating as against direct current. This question has been definitely settled by extensive tests which have demonstrated positively that the drawn-wire tungsten filament gives equally satisfactory life on either alternating or direct current. Another point relates to the durability of the drawn-wire tungsten filament during life service. Statements have been made to the effect that the drawn-wire tungsten filament loses in strength after being burned and is no stronger than the pressed filament after some hours of use. The fact is that the tungsten drawn-wire filament is many times as strong as the old pressed filament, not only at the beginning, but at any time during the life of the lamp. "Another point that needs correction is the statement that the problem of drawing filaments of pure tungsten was solved in Germany. The fact is that the credit for the development of a filament drawn from pure tungsten must be given to the General Electric Company of America alone. . . . The other development of a so-called drawn-tungsten wire is not a filament drawn from pure tungsten, but one drawn from an alloy of tungsten with another metal. From this alloy after drawing the auxiliary metal is expelled by heat, leaving the tungsten in a similar condition to that which is found in the pressed or squirted filament. The real drawn-wire tungsten filament, such as the Mazda filament, is drawn from a block of tungsten—pure tungsten from start to finish—and it is this development for which credit must be given to America."—London *Elec. Review,* March 15, 1912.

Generation, Transmission and Distribution.

Calculation of Protective Induction Coils.—F. Emde.—To protect large alternators, especially with a small number of poles, against the power rush in case of a sudden short-circuit, protective induction coils free from iron are employed. Since a considerable amount of copper is used in them they are expensive and careful design becomes of importance. The author gives a mathematical method of calculating induction coils free from iron for such purposes. The article is to be continued.—*Elek. u. Masch.* (Vienna), March 17, 1912.

Water-Power Plants in Italy.—E. Giovannoni.—The conclusion of his article giving data on water-power plants in different provinces of Italy. The equipment rating of all developed water-power plants in Italy is now 1,000,000 hp. The capital invested in the generation and utilization of electrical energy in Italy is from $160,000,000 to $180,000,000.—*Elek. Zeit.,* March 14, 1912.

Power Plant in Argentina.—An illustrated description of a new power plant in Bahia Blanca which will have ultimately a rating of 20,000 kw. The present installation contains five steam-driven 1000-kw, 6600-volt, three-phase generators. The energy is used for lighting and traction.—London *Electrician,* March 15, 1912.

Austrian Water-Power Plant.—L. Bernard.—A profusely illustrated description of the Gail power plant, which supplies energy to the city of Villach and surroundings. There are three 1750-hp turbines, each driving a 16,500-volt, three-phase alternator. Cables are used for transmission.—*Elek. u. Masch* (Vienna), March 10 and 17, 1912.

Crane.—An illustrated description of a 200-ton electrically revolving cantilever crane for a Japanese dockyard.—*London Eng'ing,* March 15.

Traction.

Reversible Boosters.—C. Turnbull.—An article giving some practical notes on the working together of reversible boosters and storage batteries in traction plants and on the saving resulting from their use.—London *Elec. Review,* March 15, 1912.

Installations, Systems and Appliances.

Heating Apparatus.—An illustrated description of new electrical heating apparatus in the form of a fabric made up into bandages, pillows or rugs. The fabric consists of chemically pure asbestos in which heating channels are provided. Within these channels resistors are so arranged that a very uniform development of heat is produced over

the whole surface. This asbestos fabric is covered on both sides by impregnated cloths so that neither dirt nor humidity can get into the resistor channels. The rheostat is shown in Fig. 1. There are four contact pieces, *h*, *e*, *i*, *g*, and a revolvable star with three contact arms, *a*, *b* and *c*. While the systems *a* and *b* are connected together, *c* is insulated

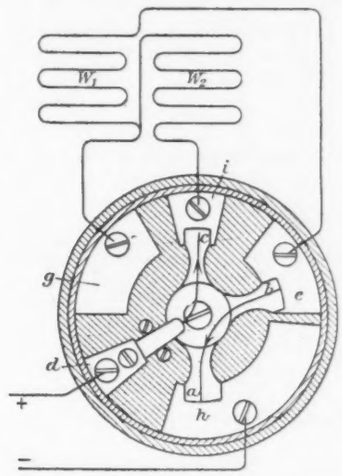


Fig. 1—Heating Apparatus and Rheostat.

from them; *c* is connected with the sliding contact *d*, while *a* and *b* are insulated from *d*. The connections to the supply circuit are made at *d* and *h*. The resistor wires consist of two halves w_1 and w_2. In the position shown in the diagram they are both in series. In other positions of the rheostat the two halves are connected in parallel or one or both are disconnected from the circuit.—*Elek. Zeit.*, March 14, 1912.

German Central Station Statistics.—G. Dettmar.—Some further statistical data on the condition of central stations in Germany on April 1, 1911. It was formerly thought that the rate of new central stations erected per year would gradually diminish, but quite the contrary is true. The rate of increase from 1895 to 1897 was 117 new stations, from 1903 to 1905 it was 236 new stations, from 1907 to 1909 it was 448 new central stations, and from 1909 to 1911 it was 548 new stations. There are at present in course of erection 698 new stations. While in 1909 about 4650 towns were supplied with electricity, at present about 11,000 towns are thus supplied. Out of a total of 2526 stations, 1769 stations supply energy to only one town, 356 supply one or two more towns, 119 supply three or four more towns, ninety-four stations five to nine more towns, ninety-four stations ten to twenty-four more towns, forty-one stations twenty-five to forty-nine more towns, twenty-three stations fifty-six to ninety-nine more towns, and eleven stations supply 100 towns or more. A total of 2279 stations generate their energy themselves, eighteen stations do so but also buy some energy from other stations, 135 stations buy energy in bulk and distribute it to the consumers without transformation, and twelve stations buy energy in bulk and transform it. The erection of new stations is not limited to small stations, but larger stations are also being built. While the mean equipment rating of German central stations was 587 kw in 1909, it was 582 kw in 1911. In 1901 there were twenty-four stations of from 1000 to 2000 kw, twenty-one stations of from 2000 to 5000 kw and nine stations with a rating above 5000 kw. In 1911 there were ninety-three stations of from 1000 to 2000 kw, fifty-nine stations with from 2000 to 5000 kw, and fifty-three stations with a rating above 5000 kw. Data are given on the average cost of installation per kw. The mean figure for water-power plants is $325 per kw; for steam plants, $281 per kw; for gas-engine plants, $332 per kw, and for combined water and steam plants, $359 per kw. The mean figures for the cost of installation for stations of different sizes are as follows: For stations up to 100 kw, $322 per kw; for stations from 100 kw to 500 kw, $328 per kw; for stations from 500 to 1000 kw, $281 per kw; for stations from 1000 to 2000 kw, $251 per kw; for stations from 2000 to 5000 kw, $251 per kw; for stations from 5000 to 10,000 kw, $217 per kw, and for stations above 10,000 kw, $248 per kw. Data are given showing that the cost of installation per kw has been reduced in recent years. Comparisons are made with analogous data for Switzerland and Austria. The use of electricity meters has increased enormously in Germany in recent years. There were used 127,000 meters in 1901, 270,000 meters in 1905, 638,000 meters in 1909 and 955,000 meters in 1911. The gas plants in Germany produce at present about 2,400,000 cu. m of gas per year. The public electrical central stations produce 2,150,000,000 kw-hr. The development of the electric central stations industrially is, therefore, almost equal to that of the gas plants. Corrected figures for the central stations show that there are in use at present in Germany 17,500,000 incandescent lamps with a load rating of 850,000 kw and heating and cooking apparatus of an aggregate of 100,000 kw. The total connections amount to 2,580,000 kw. The equipment rating of the central stations is 1,500,000 kw and the number of meters in use 1,000,000.—*Elek. Zeit.*, March 14, 1912.

Wires, Wiring and Conduits.

Feeder Protection.—R. Calmettes.—An article illustrated by diagrams discussing the systems of Merz and Price and of Hochstaedter, both of which have been described before in the *Digest.*—*La Lumière Elec.*, March 9, 1912.

High-Tension Cables.—L. Lichtenstein.—His Turin Congress paper on recent progress in the manufacture of high-tension cables.—*La Lumière Elec.*, March 9, 1912.

Electrophysics and Magnetism.

Absorbed Charge of Condenser and Temperature.—A. Zeleny.—An abstract of a Physical Society paper giving an account of an experimental investigation of the effect of temperature on the absorbed charge in electric condensers. The values of the absorbed charge obtained from a paper condenser were determined at various temperatures between — 20 deg. and + 22 deg. C. The plotted curve shows a sudden change in curvature at and below 0 deg. C., the average temperature coefficient above that point being 0.136, while below it is only 0.037. This change at the freezing point of water suggests that a large part of the absorbed charge may be due to the presence of moisture in the paraffin. The condenser used was made without boiling in vacuo. The cause of this sudden change in curvature will be investigated.—*Phys. Review*, February, 1912.

The Ranges of Alpha Particles.—H. Geiger and J. M. Neuttall.—The authors have formerly shown that there exists a quantitative relation between the range of an alpha particle and the transformation constant of the product from which it rises. This was arrived at by plotting the logarithms of the transformation constants against the logarithms of the ranges of the respective products. In this way approximate straight lines were obtained passing through the points representing the products of the uranium-radium and of the actinium series. In the present paper the authors extend this rule to the thorium series. They also show that uranium consists of two alpha-ray products the ranges of which are 2.9 cm and 2.5 cm in air at atmospheric pressure and at a temperature of 15 deg. C.—*Philos. Mag.*, March, 1912.

Vector Diagrams.—C. C. Hawkins.—An article on the use of alternating-current vector diagrams. It is pointed out that there is often a want of clearness in the mind of the student as to the meaning of vector diagrams, according to whether the resultant is the diagonal of a parallelogram or the closing side of a triangle. Diagrams are classified as circuit diagrams and space diagrams, and the latter are con-

sidered as development of an intermittent form which is called point diagrams.—London *Electrician,* March 15, 1912.

Electrochemistry and Batteries.

Purification of Water.—Three papers presented at the Turin Electrical Congress. G. Erlwein discusses in general the two electrical methods of purifying water, one being by means of ozone and the other by ultra-violet light; L. de Andreis discusses the sterilization of the water of the Rovigo aqueduct by ozone, the Siemens-de Frise system being used; M. von Recklinghausen discusses at greater length the methods of purifying the drinking water for cities by means of ultra-violet light.—*L'Electricien,* Feb. 24, 1912.

Storage-Battery Plates.—A note on a recent British patent (No. 8821, March 7, 1912) of W. E. Lake (United States Light & Heating Company of this country). Plates of the Planté type are made by subjecting a lead sheet to approximately normal pressure applied very slowly so that the crystalline structure of the lead is not impaired, and suitable indentations are produced by the molding plate, whereby large surface, non-porous, crystalline plates able to resist evenly the action of the electrolyte are produced and at the same time are mechanically strong.—London *Elec. Eng'ing,* March 14, 1912.

Units, Measurements and Instruments.

Kilowatt as the Unit of Power.—A discussion before the Berlin Electrical Society on the proposal to make the kilowatt the unit of power. Originally it was proposed to drop the horse-power, not completely at once, but to introduce the "neupferd" (new horse) for use for a time and to drop it later. However, this is not now considered necessary since even mechanical engineers are willing to adopt the kilowatt as the fundamental unit. The proposal to use the notation kW found some opposition on account of using a small letter k and a capital letter W.—*Elek. Zeit.,* March 14, 1912.

Magnetic Tests of Sheet Iron.—E. Gumlich and W. Rogowski.—By the use of special alloy steels the hysteresis loss has been greatly reduced, but the permeability is considerably below that of ordinary sheet steel at high field intensities. This is due to the presence of silicon, which is non-magnetic. The authors discuss methods by which the bundles of sheet steel which are used for testing in the Epstein apparatus can be used also for measuring the permeability with the same magnetizing coil. Epstein himself has made experiments in this direction and the present authors have also made other experiments in the Reichsanstalt. Epstein's aim was to make the method as convenient as possible. The present authors were more interested in accuracy of the results. The authors describe their method in detail and compare it with that of Epstein.—*Elek. Zeit.,* March 14, 1912.

Tests of Meters.—J. W. F. Hofmann.—An article giving in diagrams the results of comparative tests of eighteen commercial alternating-current meters based on the Ferraris principle.—*Elek. u. Masch.* (Vienna), March 10, 1912.

Röntgen Ray Apparatus.—An illustrated description of Dubilier's portable Röntgen ray apparatus, which has certain advantages in mechanical construction.—London *Electrician,* March 15, 1912.

Telegraphy, Telephony and Signals.

Continuously Loaded Telephone Cable.—A description of the new telephone cable recently laid between Abbotscliff and Cape Gris Nez for the French Administration of Posts and Telegraphs. This cable is continuously loaded and there will be direct comparison possible between it and other cables between the same points loaded discontinuously with Pupin coils. The continuously loaded cable is not mechanically objectionable and presents no increased difficulty either in laying, picking up or repairs. The copper conductor (Fig. 2), which weighs 300 lb. per nautical mile, consists of a central copper wire surrounded by five copper tapes according to the method introduced by Willoughby Smith, and the inductance loading is obtained by surrounding the conductor with a close helically wound layer of 0.012-in. steel wire, the whole being covered in the usual way with gutta percha to a diameter of 0.412 in. The attenuation constant as measured after submersion and at a frequency of 1000 cycles per second was found to be 0.00996 and 0.00987 per loop kilometer for the two circuits respectively—London *Electrician,* March 15, 1912.

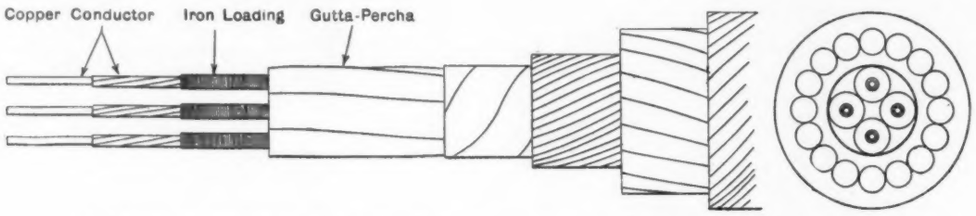


Fig. 2—Continuously Loaded Telephone Cable Laid in the English Channel (Half Size).

Electrical Testing of Telephone Cables.—E. B. Stephenson.—A short article describing in general terms the modern methods employed in testing telephone cables designed for loaded physical and phantom circuits, with reference to the practice of the Western Electric Company.—*Quarterly Journal, Univ. of North Dakota,* January, 1912.

Submarine Telegraph Cable.—H. W. Malcolm.—A continuation of his long serial in which he discusses the following subjects: General equations of the telegraphic circuit; periodic solution; the mean speech frequency; attenuation of a simple sine oscillation in a long submarine cable; experimental test of a cable with a periodic emf; representation of a square-topped emf by a Fourier series.—Lond. *Electrician,* March 15, 1912.

Book Review

The Corrosion of Iron and Steel. By J. Newton Friend. New York: Longmans, Green & Company. 289 pages, 63 illus. Price, $1.80.

There are few chemical phenomena of ordinary life more familiar than the corrosion of iron and steel, as there are few of greater economic importance to mankind. This is a textbook on the nature, causes and preventives of such corrosion. The chapters deal with the following topics: Iron and its history; the action of air and water on iron; the action of steam upon iron; theories of corrosion; whether an acid is essential to corrosion; factors influencing the rate of corrosion; the action of acids and of alkalis; the influence of aqueous solutions of single salts and of solutions of two or more salts; the action of oils; the passive state; the influence of chemical composition; electric and galvanic action; the relative rate of corrosion of iron and steel. The book is simply and clearly written and is addressed to the technologist at large rather than to the chemist. It does not present any panacea for arresting corrosion, but it marshals the facts and references relating to the rate of corrosion under different conditions.

New Apparatus and Appliances

EXHIBITORS AT N. E. L. A. SEATTLE CONVENTION.

The exhibition committee of the National Electric Light Association has allotted locations to the various firms that have thus far completed arrangements with it for space in the Armory at Seattle, Wash., where the convention will be held, June 10 to 13 inclusive. The exhibits will be placed in the drill hall, one end of which will be cut off by a partition to form a meeting room for the principal sessions. To reach this room delegates must pass through the exhibition hall. The list thus far includes the following: American District Steam Company, Benjamin Electric Manufacturing Company, Century Electric Company, Dearborn Drug & Chemical Works, Electric Storage Battery Company, *Electrical World*, Federal Sign System, G. & W. Electric Specialty Company, General Electric Company, Hubbard & Company, Hurley Machine Company, H. W. Johns-Manville Company, Minerallac Electric Company, National Electric Lamp Association, Otis Elevator Company, Philadelphia Electrical Manufacturing Company, Simplex Electric Heating Company, Wagner Electric Manufacturing Company, Westinghouse Companies, and the Weston Electrical Instrument Company. There are many others who will exhibit at the convention, but as yet negotiations have not been entirely completed.

A MOTOR-DRIVEN DISH-WASHING MACHINE.

A motor-driven dish-washing machine capable of cleansing 2000 to 2500 dishes per hour, its output being limited only by the speed of the operator in loading the dishes, is being manufactured and marketed by the Robins Conveying Belt Company, New York and Chicago. A wheel of metal framing, 5 ft. in diameter, revolves slowly half immersed in a tank of hot soapy water, and on the periphery of this wheel the plates, cups and saucers are cradled in spring clamps during the process of washing. By means of a cam arrangement each cradle is automatically opened by the time it reaches the position uppermost on the wheel, where, one at a time, the plates, dishes or cups are quickly laid in place. The cradles then automatically close as the wheel revolves, conveying the dishes down into and through the soapy water, where two high-speed propellers serve to create a strong current over the surface of each plate. Each dish thus receives an individual washing, and as the large wheel revolves at the rate of about 3 r.p.m., a single plate is immersed and being vigorously washed during 10 to 15 seconds. As the plates emerge from the soaped-water solution, a cam-operated valve is opened and sprays them thoroughly with hot clean water at 180 deg. Fahr. Another cam automatically opens the cradle, in succession, allowing the plates to slide down onto a conveyor which separates the flat dishes from the cups, discharging the latter onto one shelf and delivering the plates to a slowly rotating rack wheel, from which they are taken by the attendant. The plates come from the machine so warm that they are quickly dried by evaporation. Drains are arranged so that the large tank can be emptied and flushed, while the addition of the fresh rinsing water constantly renews the contents of the tank. The entire device can be driven by a motor of ½-hp to 1-hp rating, which operates through silent rawhide pinions, chain sprockets and worm gears. Several of these machines are in use in large hotel kitchens, and the record on a preliminary test of one of these practical installations was the washing of 17,000 pieces, nicking only two.

Motor-Driven Dish-Washing Machine.

AUTOMATIC THREAD-ROLLING MACHINE.

The accompanying illustration shows a type of automatic threading machine built by the E. W. Bliss Company, Brooklyn, N. Y. This machine has been designed especially for rolling threads on long-drawn shells of small diameter and comparatively light stock. It has four spindles revolving in a horizontal turret, the turret being revolved intermittently

Automatic Thread-Rolling Machine.

by a Geneva movement and the spindles continuously by spur gearing.

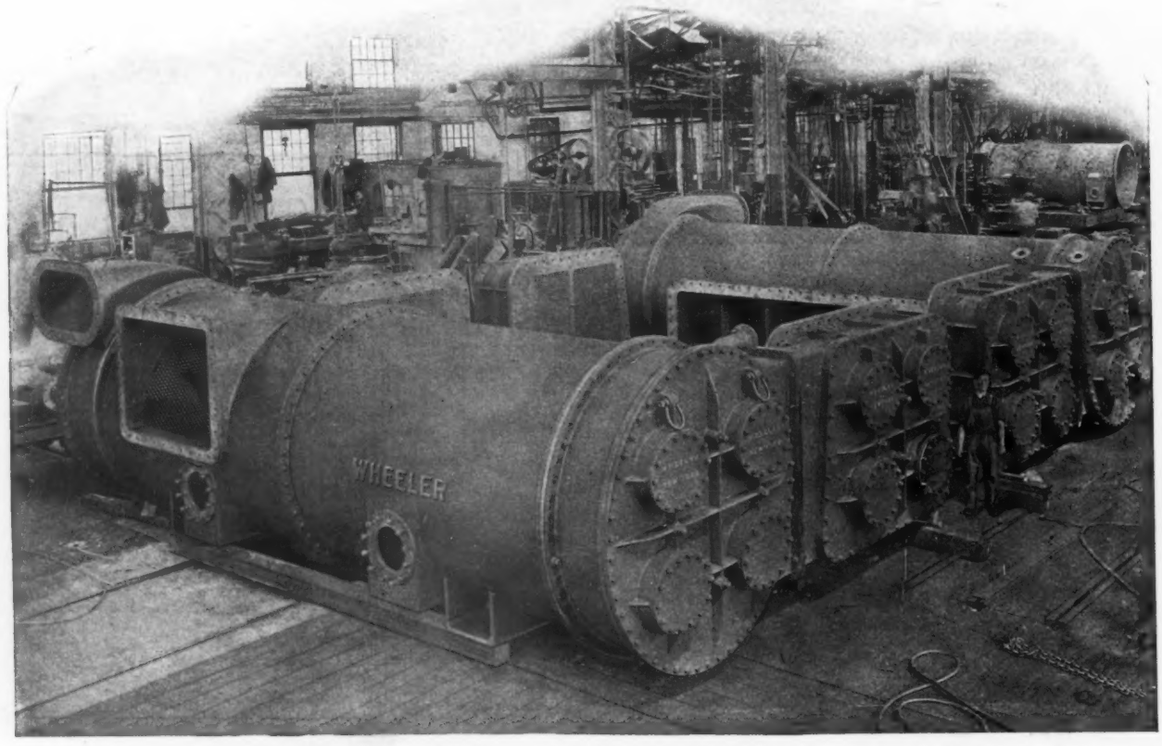
The spindles are successively brought in position for the various operations, the first or upper one being in front of the feed tube, where the shell is pushed in onto the chuck. The second is in front of the thread rolling chuck. The third or lower one is the unscrewing device, which consists of two leather-covered rolls held with spring pressure against the shell and revolving in a direction to unscrew and discharge the finished shell, the chucks being made so the drawn shell just fits over the thread before rolling. The fourth position is idle, after which the chuck returns to the feed tube again.

In threading, the chuck is so supported as to prevent springing, thus insuring a perfect thread the entire length of shell. The machine takes tubes to 1 in. in diameter by 1¾ in. high and has a capacity of 80,000 in ten hours, it being only necessary to drop the shells in the feed tube.

CONDENSER FOR 20,000-KW TURBINE.

In replacing the reciprocating engines in the Waterside station of the New York Edison Company, it was of importance that the condensing equipment of the turbo-generator maintain the highest vacuum, but at the same time only a limited floor space was available. Four reciprocating engines with a total rating of 14,000 kw were to be replaced by three turbo-generating equipments totaling 60,000 kw and occupying less than one-fourth the floor space per kilowatt. It was necessary, therefore, to install a condenser of high efficiency that would occupy the minimum floor space and at the same time would not tie up so large an investment, or require so great a volume of circulating water and power on the part of the driving turbine as to make the attainment of the vacuum unprofitable. These problems, as well as that of obtaining a condenser in which a volume of approximately 3,250,000 cu. ft. of steam per minute would be condensed at high efficiency, were solved in the design of the Wheeler dry-tube wing-base condenser illustrated herewith, together with the various condenser auxiliaries.

The condenser consists of the turbine base formed in two parts, into which the steam is directly exhausted from the vertical Curtis turbine and two large cylindrical wing condensers directly connected on either side of the base. The photograph shows the condenser assembled on the shop floor. In the foreground and rear are the wing condensers and joined to them the four water-boxes of the base condenser proper. The two cylindrical wing condensers and these water-boxes inclose the turbine base. The tube surface is arranged throughout on the Wheeler dry-tube principle, especially designed to take care of the enormous volume of vapor which had to be handled. The tubes themselves are of a special copper-aluminum alloy, never before used, and recently developed to meet the requirements imposed by the character of the circulating water which is drawn from the East River. The steam on entering the turbine base is immediately distributed to all the tube surface contained therein, and passes on to the wing condensers, which are connected to the base, by the large ports which may be seen. The air is withdrawn at the bottom of the wing condensers. The large opening near the rear water-box shown at the left is the atmospheric exhaust connection. Two of the circulating-water connections may be seen at the rear of each of the wing condensers, the other two circulating-water connections being in the rear water-boxes of the base. Circulating water is provided by two centrifugal pumps of a capacity of 30,000 gal. per minute, driven by 300-hp. steam turbines. The dry-air pump is of the vertical type, specially designed to meet the requirements of small floor space, and will maintain a vacuum of 29½ to 29.8 in. referred to a 30 in. barometer. Two of the condensers have already been installed and a third will shortly be erected. The equipment was built by the Wheeler Condenser & Engineering Company, Carteret, N. J.

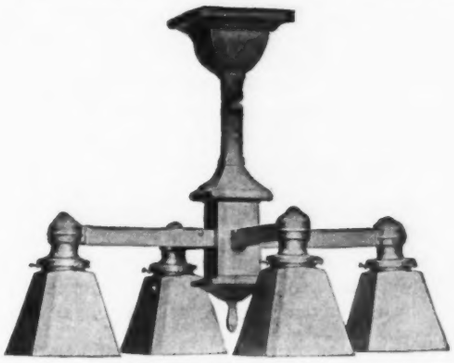


Condenser for 20,000-kw Turbine.

FOLDING LIGHTING FIXTURE.

A new electric-light fixture known as the Foldolite and made by the Beardslee Chandelier Manufacturing Company, of 225 South Clinton Street, Chicago, Ill., is illustrated herewith.

The picture shows all ready for hanging a four-light

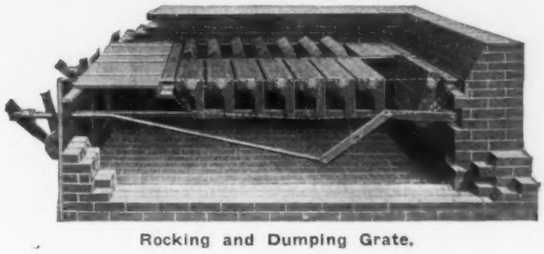


Folding Lighting Fixture.

chandelier, with a length of 16 in. and a spread of 16 in., as it appears when installed, with shades attached. The fixture is shipped to the dealer by the manufacturer completely assembled, but folded up in such a way that it is packed in a carton 18 in. x 7 in. x 7 in. No time is wasted in fastening the parts together, and when the shipment is received it is ready for the customer. The Foldolite principle is also applied to brackets, but neither the chandeliers nor the brackets are intended to take the place of a regular line of fixtures. They are designed to supply the dealer with a fixture that can be carried in stock for the man who is in a hurry. Furthermore, the folding design has the advantage that it takes up little space in the stockroom, and while it requires but little time and work to install it, it looks well in the customer's home.

ROCKING AND DUMPING GRATE.

A feature of the rocking and dumping grate made by the Kelly Foundry & Machine Company, Goshen, Ind., consists of a large rear dump grate operated independently from the main grate surface. By means of this double-capacity dump grate the largest clinker formations can be quickly and easily disposed of at the rear of the furnace where combustion terminates. The residue of combustion must be disposed of after the fuel has performed its heat-producing function, and two ways only are available, namely, to dump into the ashpit or clean out through the fire doors. Modern furnace practice favors the dumping process. There is a loss in furnace efficiency by the forward cleaning of the fires, because it disturbs combustion, and with the opening



Rocking and Dumping Grate.

of the fire doors the heat-producing function of the furnace is affected, and the loss represents both fuel and labor in getting the combustive areas of the furnace back to a normal active state again.

By referring to the illustration it can be seen how convenient it is to clean the grates, especially the rear portion, which ordinarily receives the least attention because it is out of reach of the fireman. This rocking and dumping grate, while it is a hand-firing device, embodies three features of mechanically fed furnace—the agitation and breaking up of the fuel bed by the rocking movement; the tendency of the rocking motion to shift the fuel to the rear, and the large dumping grate at the rear of the furnace which enables the operator to dump the accumulation of clinker and ash. The grate is made to fit any size furnace and with air space best adapted to the kind of fuel used. It is self-contained and does not require any alteration in the ordinary furnace to install.

METHODS OF JOINING CONDUCTORS.

By Clarence V. Jerome.

Some decidedly unique devices and methods for making joints in electrical conductors have been developed by Messrs. Carl Egnér and Seth Ljungqvist, of Stockholm, Sweden. These men sought a method whereby, with little material and with few or no tools, dependable soldered joints could be made in wires.

The methods and devices used for joining conductors of different types and for different purposes vary slightly in detail. A "self-soldering" method of connecting two aerial line wires is shown in Fig. 1. The wires to be joined are inserted in a so-called "combustible-body, double soldering tube." The device consists of: (1) a spirally wrapped sleeve of solder-coated, rosined, copper strip, of oval cross-

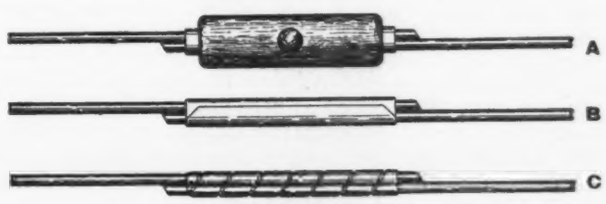


Fig. 1—Soldering Tubes for Lap Joints.

section, which somewhat resembles a McIntire sleeve and which closely fits the conductors; (2) a wrapping of sheet solder over the copper sleeve; (3) a wrapping of sheet aluminum over the solder; (4) a combustible body composed of a material similar to that of the body of a Swedish safety match, and (5) an igniting tip.

To join the two wires, their thoroughly cleaned ends, smeared with soldering paste, are inserted in the tube and the igniting tip is scraped against the side of the box in which the tubes are sold or against the side of a Swedish matchbox. This ignites the tip or cap, which in turn ignites the combustible body. Sufficient heat is developed to melt the sheet solder which flows between the spaces of the copper strip as shown in the finished joint (Fig. 1 C). The sheet-aluminum wrapping confines the solder, and since solder will not stick to aluminum the sheet can be readily

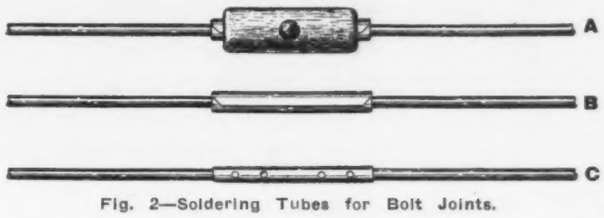


Fig. 2—Soldering Tubes for Bolt Joints.

removed. The burnt combustible material can be readily broken away with the fingers. Not only does the aluminum sheath confine the solder to the place where it will do good work, but it distributes the heat and protects the joint from the oxidizing effect of the gases developed by the combustion of the combustible body. A combustible body in burn-

ing does not fall to pieces, but retains, approximately, its original form. This feature is of importance in that it minimizes danger of a fire. Wind, rain or snow, it is claimed, will not put out the combustible body after it has once ignited.

A solder of a composition of 63 per cent tin and 37 per

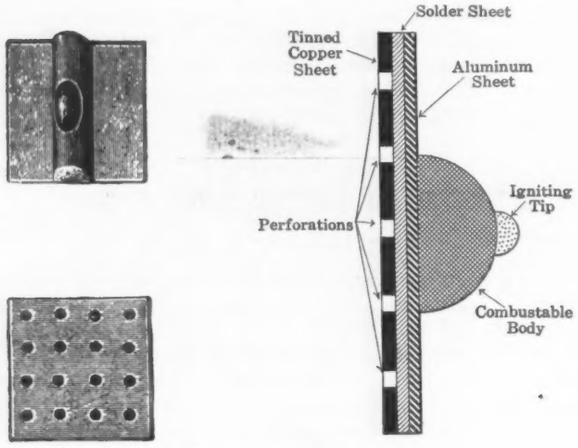


Fig. 3—Soldering Plates.

cent lead is used for the solder sheet. The volume of solder has been proportioned for each joint, so that there is just about the right amount and there is just about enough of the combustible body properly to melt the solder and to insure a thorough weld It requires about fifteen seconds for the combustible body to burn, but the joint should not be disturbed for two or three minutes, so it will have ample time to set. As shown in the table, a joint, properly made as described, in hard-drawn copper wire has practically the same strength as that of the wire itself. The weakening effect of the heat action is of no importance.

Splices of another form, termed merely "double soldering tubes" (Fig. 1 B), are manufactured. These are like those above described (Fig. 1 A), except that the combustible body is omitted. Heat from an alcohol or blow torch is required to effect a splice. The double-tube joints are recommended by the manufacturers for outdoor line wires.

For splices in interior wiring are recommended "single soldering tubes," which are manipulated in practically the same way as are the corresponding double ones, with the exception that the ends of the wires to be spliced are butted together in and at the centers of the tubes. The result is a butt joint rather than a lap joint.

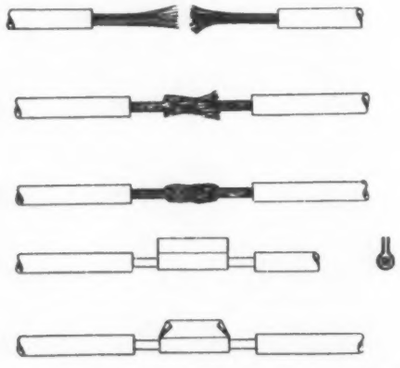


Fig. 4—Method of Soldering by Means of Plates.

For making joints in small stranded conductors "soldering plates" (Fig. 3) have been developed. The operation of splicing a stranded conductor with a soldering plate is illustrated in Fig. 4. The insulation is removed from the conductor ends and they are scraped clean. The fanned-out ends of the two conductors are meshed together for a distance of from ½ in. to 1 in., depending upon the size of the conductor, and the joint is twisted firmly together to compact it. Then the soldering plate is bent around the joint with the copper-plate side inward. It is squeezed together with the fingers, or, preferably, with a pair of pliers, so as to inclose the joint very tightly. The corners of the plate are bent over, which holds the plate in position. External heat is applied if the plate has no combustible body. The manufacturers claim that the heat of a match is sufficient for soldering the smaller conductors when a plate without a combustible body is used. A soldering lamp or torch should be used for the larger conductors. The application of heat is continued until all of the solder flows down into the joint. The aluminum plate is removed after the solder has set.

The tensile strengths of typical double-tube joints, as compared with the strengths of joints of other types in wire of the same size, are given in the table. The values in the table were computed from values in metric units obtained in tests made by the inventor of soldering tubes.

TENSILE STRENGTH OF JOINTS IN 3-MM HARD-DRAWN COPPER WIRE.

3 mm. = 0.118 in. = between No. 8 (0.128) and No. 9 (0.114) B. & S. gage.

Wire Without Joint, Pounds.	JOINTS, POUNDS.			
	Unsoldered Western Union.	Soldered.	Sleeve.	Soldering Tube.
682	240	651	638	673
682	246	660	647	664
686	246	629	660	671
682	246	669	653	673
701	246	678	634	675
701	246	671	656	667
701	246	678	651	668
701	246	673	629	669
701	246	660	656	673
701	246	660	623	673
Average: 688	244	665	645	672
Loss in per cent	64.5	3.4	6.3	2.4

Sleeve joints, which were made with only three or three and one-half long turns and with the wire ends extending parallel to the line wires, were found to have little tensile strength. The wires were drawn out of them, as tension was applied, before the stress reached 440 lb. Even with four turns the spliced wires gave indications of pulling out of the sleeve. Tube joints made with three and three and one-half long turns and short end-turns yielded somewhat. Therefore, all of the tabulated tests on sleeve joints were on specimens that were made with four long turns in the sleeve and the free ends made up into short turns.

It is plain from the table that the soldering tube joints were stronger than any of the others tested. While they are apparently but little stronger than the soldered joints, it is maintained by their inventor that the soldering tube joints should, in general, give better service and have longer lives, because their quality depends but little upon the skill and watchfulness of the workman that makes them.

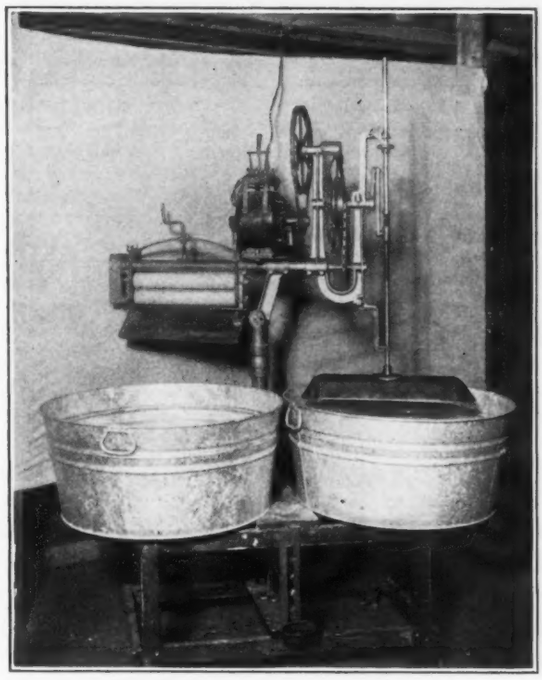
Joints made in 3-mm iron wire with soldering tubes were also tested for tensile strength. Of twelve such joints tested, eight broke at a distance of 2 cm or more from the joint, so it is apparent that the heat of soldering the joint had no effect on the strength of the wire. All of the joints developed practically the normal strength of the wire. The loss in strength averaged but 0.6 per cent.

As to conductivity, it is well established that almost any soldered joint that is mechanically strong enough to hold itself together will have a conductivity as good as that of an equal length of the wire, and a joint made with a soldering tube is no exception. However, in designing the tubes the fact that the solder used has but one-tenth the conductivity of copper was recognized, and the dimensions of the tubes were partly determined on this basis.

The Swedish manufacturer is represented in this country by Mr. A. E. Sylven, 29 Broadway, New York.

ELECTRIC WASHING MACHINE.

A motor-driven washing machine which utilizes a new principle of construction, permitting the use of ordinary wash-tubs, is shown in the accompanying illustration of the vacuum washer, built by the Twentieth Century Brass

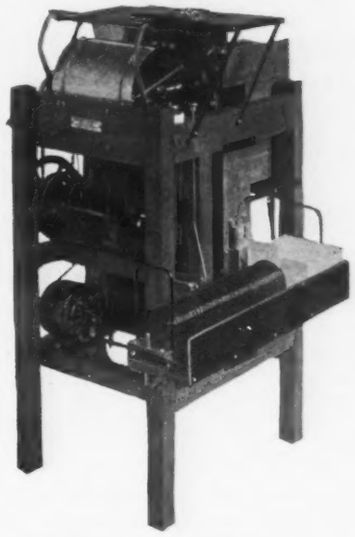


Electric Washing Machine.

Works, Minneapolis, Minn. The entire motor-driven mechanism, including the ringer, is mounted on a pedestal between the two tubs, into either of which the vacuum cup can be dropped and operated. A crank-shaft oscillates this washing cup through a vertical travel of 8 in. to 10 in., a spring attachment imparting a final "kick" to the motion at the end of its path, to simulate the action of the woman at the washboard. A cam rotates the vacuum cup about its vertical axis, so that all parts of the tub are reached. Either the wringer or washer mechanism can be operated separately, or both simultaneously, through knob clutches like those used on sewing machines. A throw-over switch reverses the motor to change the direction of wringer operation, so that the operator may wring clothes out of either tub, from one tub to the other, or into or out of the boiler.

PHOTOGRAPHIC PRINTING PRESS.

What the printing press is to ink, type and paper, the electric printing machine illustrated herewith is to the rapid and uniform production of photographs on sensitized paper. Instead of the awkward, laborious methods of the ordinary photographer's printing frame, this machine enables the sensitive paper or post cards to be fed against the negative at the rate of 1800 an hour, exposed to a strong actinic illumination for a definite, uniform period, and then delivered to the japanned carrying tray still remaining, in which they can be dipped directly into their developing and fixing bath. A ⅛-hp motor drives the machine, operating the various conveyors. The paper to be printed is fed into the machine as into a job press, and when brought opposite the negative an auxiliary contact lights a group of 100-watt tungsten lamps in the exposure cabinet, the interval being adjustable for any definite period. Except when making an exposure, these white printing lamps are extinguished, the machine being operated in the ruby light of the dark-room. Trial exposures to test the density of the negative can be made with the aid of a hand printing frame which folds over the lamp cabinet. When the proper exposure has been determined, the time required is marked on the negative, enabling identical and uniform results to be obtained at any

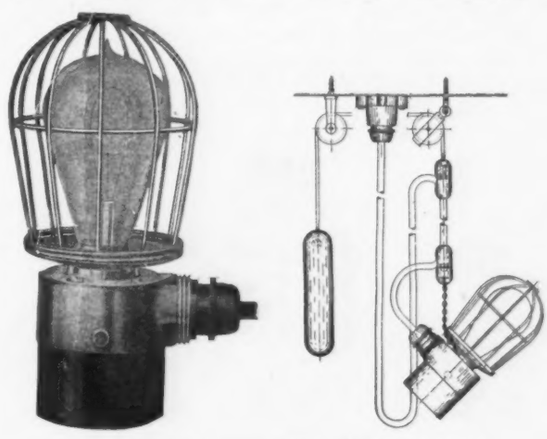


Photographic Printing Press.

future time. The machine will print from negatives up to 8 in. by 10 in. in size, and although its principal application is the production of commercial pictures, such as post cards, advertising matter, etc., portrait makers who have trouble getting uniform prints can use it to advantage in printing even a few photographs. The photo-autopress is made by the G. M. Dye Company, Minneapolis, Minn.

MAGNETIC INCANDESCENT LAMP SOCKET.

A useful device for local lighting in industrial establishments is illustrated herewith in the form of a portable lamp equipped with an electromagnet so that it will adhere to any mass of iron against which it may be placed. The complete equipment, including the lamp, the magnet and



Incandescent Lamps with Magnetic Socket.

the switch mechanism, occupies a space less than 3 in. in height and 2.5 in. in diameter and weighs less than 2 lb. The magnet winding is in series with the lamp filament and consumes very little power. The current is controlled by a switch operated by means of a knurled disk forming the central pole piece of the magnet. This switch cannot be

operated when the magnet is in use, an obvious advantage. Grasping the lamp in hand, after the current has been turned on and the lamp lighted, and pressing the little push-button extending radially from the side of the switch and receptacle casing above the magnet, de-energizes the magnet so that the lamp may be placed, removed or changed in position, while releasing this button brings the magnet into service again. After the current has once been turned on by the switch it remains on irrespective of whether the magnet is cut out, and consequently it is never necessary to manipulate the lamp without light.

For use with the self-adhering lamp there has been developed a counter-balance equipment consisting of two insulating clamps. One is detachably connected to the lamp by a short chain and clamped to the flexible cable close to the plug inserted in the lamp receptacle, and the other, at a suitable distance beyond, is attached to a strong cord passing over one or more ceiling pulleys, with a balancing weight at the other end. All strain between the lamp and weight is taken by the flexible lamp connecting chain, the conducting cable between the clamps and the cord, thus relieving any pulling on the plugs or sockets.

The above-described lighting equipments have been developed for 110-volt and 220-volt direct-current service by the Sachs Laboratories, Inc., Hartford, Conn.

INCANDESCENT LAMPS FOR ELECTRIC-VEHICLE SERVICE.

The different systems of electrically lighting automobiles have passed from one stage of development to another until at the present time there are many systems on the market that have demonstrated their effectiveness and durability.

The lighting of electric vehicles has not passed through the various stages of development as has that of steam-driven or gasoline-driven cars. Incandescent electric lamps have always been the logical means of lighting such vehicles. The first lamps used for this service were the carbon-filament lamps. These lamps are standard in from 1 cp to 8 cp for use on from 12-volt to 130-volt circuits. The next development in lamps for this type of service was the tantalum lamp; but this lamp has been superseded for practically all classes of work by the tungsten lamp.

The Mazda type of tungsten lamp, when designed for the comparatively low voltages used on the majority of electric vehicles, has a relatively short thick filament that approaches in ruggedness that of the carbon-filament lamp. Unfortunately, in the higher range of voltages in use on electric vehicles this class of lamp cannot be made in very low candle-powers or with a coil filament. It is standard

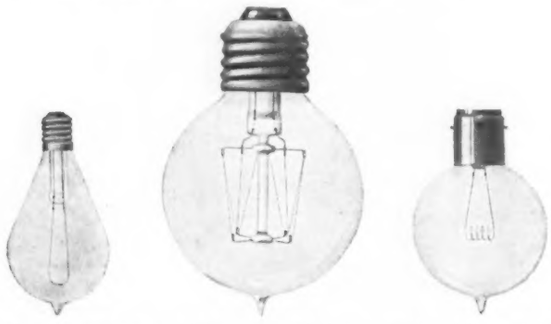


Fig. 1—Carbon and Tungsten-Filament Automobile Lamps.

in the 15-watt and 25-watt sizes. In the lower candle-powers, such as for the tail and meter lanterns, carbon-filament lamps are used.

Practically all electric head lanterns are fitted with parabolic reflectors. Obviously, if a source of light of infinitesimal diameter could be obtained, all this light would be reflected in a straight beam from the lamp. Practically, it is impossible to obtain a source of light of pin-head dimensions or smaller, but in lamps of the 6-volt range the "point source" is very closely approached in the helical coil type of filament. In this type a source of light less than ¼ in.

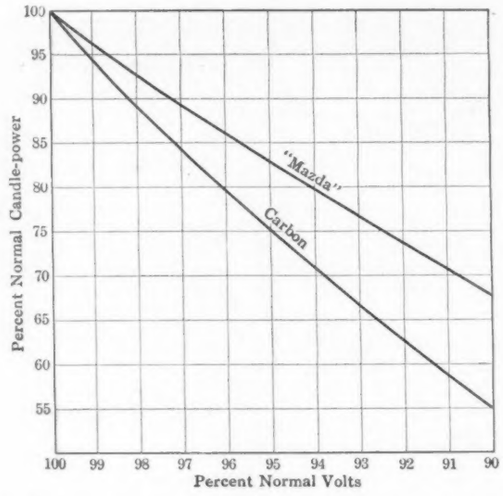


Fig. 2—Comparative Variation of Candle-Power and Voltage of Carbon and Metallic-Filament Lamp.

in diameter is obtained and for practical use on machines this is sufficiently small.

In Mazda lamps of the 21-volt to 90-volt range it is necessary to wind the filament upon a spider. This gives a source of light approximately ¾ in. x 1 in. in size and destroys the true focusing properties of the lamp. For voltages commonly found on electric vehicles the close-coil carbon-filament lamp has the best focusing qualities. The source of light in this type of lamp is the smallest obtainable for this class of work.

However, for equal consumption of energy greater candle-power is obtained from the Mazda lamp. Thus, a 15-watt carbon lamp has a mean horizontal candle-power of approximately 6, while that for a 15-watt Mazda lamp is approximately 12. From tests made it has been evident that the roadway is illuminated for a greater distance in front of the car and at the same time the light is distributed more widely with a 12-cp Mazda lamp than with a 6-cp or even an 8-cp close-coil carbon lamp, notwithstanding the poorer focusing qualities.

Fig. 2 shows the approximate comparative decrease in candle-power with voltage for the two types of lamps. There is a variation of more than 10 per cent between charge and discharge voltage of storage batteries. Assuming the batteries are discharged to 90 per cent of their full voltage, it is seen that at this point the percentage of normal candle-power of Mazda lamps is more than double that of the carbon lamps.

Automobile lamps are in general fitted with one of three types of bases—the candelabra screw, the bayonet can-

Fig. 3—Standard Bases for Automobile Incandescent Lamps.

delabra, or the miniature screw base. The most satisfactory for this class of work is the bayonet candelabra, as the frequent jars will not work it loose from the socket. The three types of base mentioned above are shown in Fig. 3. Mazda electric vehicle lamps are regularly fitted with the standard medium screw base.

Industrial and Commercial News

EVIDENCE of business expansion and of growth of confidence in industrial conditions may be found in the record of new incorporations in the month of March. This showed that papers filed in the Eastern States last month for companies with a capital of $1,000,000 and over authorized issues of $161,078,000, an increase of $59,778,000 over February figures, and of $20,168,000 as compared with March, 1910. Charters taken out during the month by other companies with an individual capital of $100,000 or more, but less than $1,000,000, brought the total for the month up to $252,363,000, against $173,340,000 in February and $228,518,000 in March, 1910. The record of the week in the business world shows no unexpected changes in any of the leading industries. Suspension of work in the coal fields took place April 1, but there seems to be every reason to believe that early settlement of differences will be reached between miners and operators. Traffic conditions in the West continue to show improvement. Steel prices are becoming firmer, and the prospects for increased business at higher profits are becoming more favorable. Rates in the money market April 3 were: Call, 2¾@4 per cent; ninety days, 3¼@3½ per cent.

THE COPPER MARKET.

Encouraged by the buoyant tone of last week's market, the leading selling interests carried their campaign for higher prices still farther this week, advancing quotations for electrolytic on April 1 to a 15⅞ to 16-cent basis. Some of the more radical elements on the producing side talk of even higher prices. Domestic buying this week was not in large amounts, and this reaction from last week's activity indicates very clearly that 16 cents per pound is virtually the upper limit at which consumers will enter the market under present industrial conditions. Inquiries have diminished in number and size since the new prices were made, and there is also reason to believe that many important projects under contemplation involving fair amounts of copper have been set aside until prices become more reasonable. Domestic consumers, as a whole, seem well supplied, and buying in this country is due largely to action of a few scattered melters whose needs require them to purchase in spite of the advance. Foreign buying has been the sustaining element of the market this week. Exports for the month, including April 3, aggregate 3,022 tons. The daily call on the Metal Exchange April 3 quoted copper as per the accompanying table.

Standard.	Bid.	Asked.	Settling Price.
Spot	15.25	15.75	.....
April	15.55	15.70	15.62½
May	15.55	15.70	15.62½
June	15.55	15.75	15.65
July	15.55	15.75	15.65

The London market April 3 was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	69 0 0	69 15 0
Standard copper, futures	69 18 9	70 12 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	15.62½c	13.65c
London, spot	£71 0 0	£60 16 3
London, futures	72 2 6	61 10 0
Best selected	75 0 0	65 5 0

INDUSTRIAL AND COMMERCIAL NOTES.

Great Falls Power Company's System.—John D. Ryan, president of the Great Falls Power Company, of Great Falls, Mont., gives in a letter to a New York banking house which has purchased $5,000,000 first-mortgage 5 per cent gold bonds of this company and is now offering them at 96½ and interest, yielding about 5¼ per cent, some valuable data in connection with the company and its plants. He states that the property of the company includes practically all of the land, water rights and available power sites on both sides of the Missouri River, extending from a point just below the city of Great Falls, Mont., for about 8 miles down the river. At Rainbow Falls, at about the middle of this 8-mile stretch of land, the company completed in 1910 a 21,000-kw hydroelectric station. The energy generated at this station is transmitted over a three-phase system to the copper mines at Butte, 130 miles away, and to the smelters at Anaconda and Great Falls. All of the apparatus used in the power house and in the substations at Butte and Anaconda was furnished by the General Electric Company. The company also owns a dam and power house at Black Eagle Falls, 2 miles above Rainbow Falls, having an available head of about 45 ft., where 10,000 hp is developed. All of this energy is sold to customers at the falls. Below Rainbow Falls the company owns several other power sites, as yet undeveloped. Some of the energy generated at the plant at Rainbow Falls is sold to the Great Falls Electric Properties Company, and large blocks are also taken by many of the industrial companies in the section. Large contracts are in sight from transcontinental roads for energy to be used after the electrification of their systems. The $5,000,000 bonds now offered are part of a total authorized issue of $15,000,000. They are dated May 1, 1911, mature May 1, 1940, and bear interest at 5 per cent per annum, payable semi-annually in New York. They are subject to call as a whole or in part at 107½ and interest on any interest date on six weeks' notice. These bonds are secured by an absolute first mortgage on all the property, rights, licenses and franchises of the company, now owned or hereafter acquired, except securities of other corporations. The property covered by the mortgage is valued at $9,331,595. A sinking fund of 1 per cent per annum on all bonds authenticated will, it is estimated, retire nearly one-half the issue before maturity. Net earnings in 1911 were $665,013, from which $122,499 was deducted for interest on funded debt and $10,806 in bond discount charged off, leaving net divisible income of $531,706. Substantial increase is expected in 1912. The company has outstanding $10,000,000 capital stock, on which an initial dividend of 1½ per cent was paid in November, 1911, and it is the expectation of the company to pay dividends aggregating 3½ per cent in the present calendar year. Additional bonds can be issued only under carefully guarded restrictions.

Electric Locomotives for Southern Pacific Company.—Six direct-current 60-ton Baldwin-Westinghouse electric locomotives and twenty Westinghouse car equipments have been purchased by the Southern Pacific Railroad Company, for operation on the Southern Pacific and the Pacific Electric Company properties. Both the car and locomotive equipments are arranged for operation on either 600 volts or 1200 volts. Most of the property now operates at 600 volts, but there are portions at 1200 volts, and the double-voltage equipment was selected so that it might be used on any portion of the system and on such 600-volt or 1200-volt extensions as may be built in the future. The 60-ton locomotives will have an aggregate motor capacity of 1000 hp each and are said to be the largest 1200-volt locomotives ever built.

Specifications for Belgian Pumping Stations.—The Bureau des Renseignements, 15 Rue des Augustins, Brussels, Belgium, will receive tenders for the mechanical and electrical equipment of six pumping stations on the Charleroi Canal, Brussels. Specifications and plans, price 10 cents and $2.25 respectively, are obtainable from the above bureau. Further details can be obtained by application to the Bureau of Manufactures, Washington, D. C., for Schedule No. 8460.

Westinghouse Machine Meetings Postponed to April 19.—The special meetings of stockholders of the Westinghouse Machine Company scheduled for March 29 to vote on increasing the capital stock and increasing the indebtedness of the company, as mentioned in the *Electrical World* Jan. 27, were postponed until April 19.

Aluminum Notes and Prices.—The aluminum market continues steady. Prices per pound in ton lots April 3 were: No. 1 ingot, 20@21 cents; rods and wire, base, 31 cents, and sheets, 33 cents.

Carolina Power & Light Puts Its Blewitts Falls Plant in Operation and Acquires Asheville (N. C.) Property.—On April 1, according to schedule, the Carolina Power & Light Company, of Raleigh, N. C., and 71 Broadway, New York City, placed its 30,000-hp hydroelectric station at Blewitts Falls in operation, and the plant is now supplying about 8000 hp to the Southern Power Company, and several thousand horse-power in addition to the Yadkin River Power Company. References to this station can be found in these columns in the issues of the *Electrical World* March 2, April 20, May 4 and Aug. 5, 1911, and a description of the plants, capitalization, subsidiaries, territory, etc., of the Carolina Power & Light Company can be found in the issue for Nov. 11, 1911. The energy delivered to the Southern Power Company is furnished under contract, there being no financial connection between this company and the Carolina Power & Light Company. The latter, however, owns the controlling interest in the Yadkin River Power Company. With completion of its hydroelectric plants, the Carolina company plans gradually to close down its steam stations and hold them as a reserve for the water-power system. The Carolina company has just acquired the Asheville Electric Company, which does the street-railway, gas, electric light and power business in Asheville, N. C., and adjacent territory. A new company, the Asheville Power & Light Company, has been incorporated by the purchasers, with a capital of $2,000,000, to operate the newly acquired properties. The new company has $1,000,000 common stock and $1,000,000 preferred stock. About $500,000 of the latter will be sold, and some bonds will be issued shortly. The change in ownership was effective April 1.

Rockford Electric Company.—In a recent letter relating to the sale of bonds R. E. Breed, president of the Rockford Electric Company, gives some interesting facts about the company. The company does the entire commercial electric-service and steam-heating business in Rockford, Ill., a city of about 50,000 population, 85 miles west of Chicago. It has a fifteen-year contract for city lighting and also a contract for furnishing all the electrical energy needed by the Rockford & Interurban Railway Company. The company's principal franchises extend for fifty years from 1908. The growth in demand for service has made necessary large additions to the plant. Notwithstanding the operation of the plant during reconstruction the figures for 1912 show an increase of 39 per cent in net earnings over the preceding year. There has been a large growth of power business with the increase of the volume of manufacturing in Rockford. The company had outstanding on March 5, 1912, $200,000 in 6 per cent preferred stock, $1,500,000 in common stock and $1,531,000 in 5 per cent bonds. The authorized bond issue is $7,500,000.

A Foreign Trade Handbook.—The Bureau of Manufactures, Washington, D. C., is preparing a 56-page bulletin that will be of great assistance to manufacturers and others interested in sending out letters, catalogs, etc., for broadening their foreign trade. This bulletin will contain answers to such questions as "What language is best to use?" "In what currency and in what units of weights and measures should prices be quoted?" "What postage should be placed on the catalogs or the letters?" "Can we prepay replies from prospective customers?" Replies are given to many other questions of equal importance. Conversion tables of every description are given in this bulletin, which is entitled "Factors in Foreign Trade." These tables show readily such data as the equivalent price per meter in Mexican currency of cloth quoted at 50 cents per yard in United States currency. Summaries of foreign postal rates are also given. Those desiring copies of the bulletin, which will be available for distribution within a short time, should apply to the Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

Financial

Proposed Unification of Surface and Elevated Railways in Chicago.—At a meeting of the local transportation committee of the City Council of Chicago on March 27 Ira M. Cobe was present, speaking for Samuel Insull and Henry A. Blair, as well as himself, as representing the financial interests behind the elevated and surface railway companies of Chicago. Mr. Insull is chairman of the elevated railways; Mr. Blair represents the Chicago Railways Company, operating the surface lines on the North Side and West Side, and Mr. Cobe the Chicago City Railway Company, with its surface lines on the South Side, as previously noted in these columns. In answer to questions by the members of the committee, Mr. Cobe said he believed that there would be no financial difficulty in arranging a merger of all the surface and elevated railway lines of Chicago. The capitalists in interest propose to offer universal transfers between the elevated and surface street railways of Chicago for a single 5-cent fare within the limits of the city; also rapid transit on the elevated lines, taking care of the long hauls, as well as through-route operation on the elevated lines. Mr. Cobe and his associates are willing to promise relief from the congestion in the downtown business district by the use of a municipally owned subway in the central district whenever in the judgment of the city such a subway or subways shall be built. Mr. Cobe explained that the men interested do not own the shares of the elevated-railway companies but have an option on them at a certain price. The valuation of the properties of the elevated-railway companies is in progress, and it may be that this valuation will be less than the price put upon the stock. In that case the difference might be made up by providing facilities for better transportation. There was a general informal discussion, and Mr. Cobe said that the financial men in interest were not only willing but anxious to discuss the proposed merger.

Hall Signal Reorganization Plan.—Jules S. Bache, Newman Erb, William F. Morgan, William P. Hall and George A. Horwitz, the committee which has been engaged in preparing a reorganization plan for the Hall Signal Company, have submitted a reorganization plan to the stockholders of the company. This plan provides for the formation of a new company to be capitalized as follows: (1) $1,000,000 6 per cent twenty-year convertible debenture bonds, callable at par and convertible at holder's option into preferred stock at par; (2) $2,000,000 7 per cent cumulative preferred stock, and (3) $3,000,000 common stock. The new company will acquire the property of the Hall Signal Company, subject to the present first mortgage of $250,000. Present stockholders will have the privilege of subscribing at $100 per share for new preferred stock in an amount equivalent to 50 per cent of their present holdings and will receive with such preferred stock common stock of the new company in an amount equivalent to present holdings. It is contemplated to purchase the indebtedness owing by the Hall Signal Company and pay therefor in part new convertible debentures at par. The new company will be assured of $1,000,000 fresh capital, of which up to $500,000 may be used to purchase such debts of the Hall Signal Company as the creditors will not consent to sell for the new convertible debentures. It is contemplated that an underwriting syndicate will be formed to take such preferred stock as may not be subscribed for by present holders within a time to be prescribed.

Allis-Chalmers Bonds Formally Defaulted.—On April 1 the ninety days grace on the unpaid coupons of the $11,148,000 first-mortgage 5 per cent bonds of the Allis-Chalmers Company expired and the company became formally open to receivership. The interest will be advanced by the underwriting syndicate mentioned in these columns last week to all holders of Allis-Chalmers bonds who accept the reorganization plan, as soon as the plan is declared effective. The official notice sent to security holders describing the reorganization plan contains a letter by D. W. Call, president of the Allis-Chalmers Company, which gives the financial condition of the company on Dec. 31, 1911, as follows:—Current assets: Notes and discounts receivable taken at reduced values, $3,544,816; inventories taken at reduced values to a going concern, $4,760,905; cash, $931,047; total, $9,236,768. Current liabilities: Notes and coupons payable, etc., $2,560,102; coupon due Jan. 1, 1912, on first-mortgage bonds outstanding, $278,700, leaving net current assets of $6,397,966. The letter also contains brief descriptions of the plants of the company and a general statement covering the operations of the company over a period of several years.

Cumberland County (Maine) Power & Light Offering.—Banking interests are offering $100,000 of the 6 per cent cumulative preferred stock of the Cumberland County Power & Light Company, of Portland, Maine. This company, as set forth in a circular describing the offering, is a Maine corporation which has acquired practically all of the common stock of the Portland Electric Company, practically all of the common stock of the Lewiston, Augusta & Waterville Street Railway, and has leased the Portland Railroad Company. It owns a hydroelectric plant on the Saco River, about 25 miles from the city of Portland, having a capacity of 8000 kw. A description of the properties controlled shows that the Portland Railroad Company was organized under the laws of Maine in 1863, operates 103 miles of track, and owns a generating plant with a capacity of 6000 hp. The Portland Electric Company owns and controls two water-power sites situated on the Saco and Presumpscot Rivers, within 20 miles of Portland, and a steam station centrally located in Portland, having a combined capacity of 8070 kw. The transmission lines extend to Portland and to Sanford, Maine. The Lewiston, Augusta & Waterville Street Railway was incorporated under the laws of Maine and owns a system of local and interurban lines operating in the central part of Maine, embracing about 140 miles of track. The capitalization of the Cumberland County Power & Light Company consists of $2,700,000 common stock, $2,300,000 preferred stock and $947,000 bonds. The combined statement of operation of the company and its subsidiaries for the year ended Dec. 31, 1911, shows gross earnings of $2,019,618, operating expenses of $1,285,534 and net earnings of $734,084.

Reorganization Sale of Illinois Tunnel Company.—Properties of the Illinois Tunnel Company, of Chicago, were sold at public auction on March 26 for $5,000,000 to Louis C. Krauthoff and William S. Tod, purchasing committee of the reorganization committee appointed by the bond and stockholders of the Chicago Subway Company, the Chicago Warehouse & Terminal Company, the Illinois Tunnel Company and the Illinois Telephone Construction Company. The sale was conducted by a master in chancery. Only one bid was submitted. The notice from the City Council in regard to the investigation into the number of telephones installed by the tunnel company on June 1, 1911, was also read. Officials of the tunnel company say that the sale will facilitate the reorganization of the allied companies on a sound financial basis. The properties consist of the system of electrically operated narrow-gage freight railways in tunnels under the central business streets in Chicago and an automatic telephone-exchange system, the cables being carried through the tunnels.

United Electric Company of New Jersey Bonds.—New York banking interests are offering $1,000,000 first-mortgage 4 per cent gold bonds of the United Electric Company of New Jersey, due 1949. This company operates without competition, supplying energy in Newark, Jersey City, Hoboken, the Oranges, Montclair and Elizabeth, N. J., serving a total population of over 1,000,000 people. In 1907 the United Electric Company was leased to the Public Service Corporation of New Jersey in perpetuity, the lessee guaranteeing 5 per cent dividends on the United company's $20,000,000 stock, assuring payment of interest on these bonds, and obligating itself to provide for payment of principal at maturity, thus making the issue the direct and underlying obligation of the Public Service Corporation of New Jersey. For the year ended Dec. 31, 1911, the property of the United Electric Company earned $4,079,438 gross and net earnings available for interest of $2,291,367. The interest charges were $778,450, and the surplus after charges was $1,512,917.

Canadian General Electric's Returns.—The report of the Canadian General Electric Company, Ltd., for the year ended Dec. 31, 1911, states that that year was the most prosperous in the history of the company. A summary of the income account shows profits of $1,405,890, an increase of $494,682; depreciation of $353,722, an increase of $165,634; interest of $162,423, an increase of $85,603; total deductions, $516,145, an increase of $251,237; a balance of $889,745, an increase of $243,445; dividends of $525,109, an increase of $30,485; a surplus of $364,636, an increase of $212,960, and a total surplus of $2,345,312. The stockholders of the company will meet on April 25 to vote on a proposal to increase the authorized capital stock issue by $4,300,000, making the total capital $12,000,000.

Improvement in Canadian Westinghouse Earnings.—Net earnings of the Canadian Westinghouse Company, Ltd., were $1,010,154, an increase of $312,761, and the surplus for the year, after payment of $350,128 for dividends and after $335,794 had been written off for depreciation reserve, was $324,232, an increase of $133,723. The total surplus at the end of the year was $1,050,845. President George Westinghouse in his remarks to the stockholders said that the volume of output increased approximately 40 per cent over the previous year, and that the high standard previously set up in design, engineering application and quality was fully maintained.

H. L. Doherty & Company Buy Elyria (Ohio) Properties.—The electrical business of the Citizens' Gas & Electric Company, the Ely Realty Company and the Elyria Milling & Power Company, which are the three companies operating electric plants in Elyria Ohio, some 20 miles from Cleveland, has been purchased by H. L. Doherty & Company, 60 Wall Street, New York. These new acquisitions will be consolidated by the purchasers into one company, for which a name has not been selected as yet. The lighting contract which the Citizens' company has with the city of Lorain will be carried out by the new owners.

Arkansas Valley Railway, Light & Power Stock Offering.—Denver banking interests are offering 7 per cent cumulative preferred stock of the Arkansas Valley Railway, Light & Power Company at 97½ and accrued dividend. This company, as noted in these columns Feb. 24, is a consolidation of a number of public-utility companies located in the valley of the Arkansas River, in Colorado. H. M. Byllesby & Company, of Chicago, are interested in the properties, for which the Standard Gas & Electric Company of Delaware is the holding company.

New York & Queens Electric Light & Power Company Earnings Up.—Gross earnings reported by the New York & Queens Electric Light & Power Company of Long Island City, N. Y., for the year ended Dec. 31, 1911, were $777,642, an increase of $90,416 over the gross earnings in the previous year. Expenses were $405,059, an increase of $73,083, and net earnings were $372,583, a gain of $17,333. The surplus, after deduction of interest charges and amortization, was $149,697, and this was $9,294 larger than in 1910.

Holophane-Fostoria Consolidation.—The General Electric Company has recently completed negotiations for taking over the entire Holophane organization, consisting of both sales and manufacturing departments. The Fostoria Glass Specialty Company will be united with the Holophane organization, probably in the form of a new company. The sales and engineering parts of the business will be directly under the charge of V. R. Lansingh, while the manufacturing will be under the charge of E. O. Cross.

Pacific Telephone & Telegraph Company Broadens Its Activities.—The Bay Cities Home Telephone Company, an independent company serving San Francisco and nearby sections, has been acquired by the Pacific Telephone & Telegraph Company. The property involved is said to represent an investment of about $12,000,000.

Havana Electric Consolidation.—All details of the preliminary work incident to the consolidation of the Havana Electric Railway Company and the Gas & Electric Company of Havana have been completed. Details of the merger were given in the *Electrical World* March 16 and 30.

Marconi Company Stock Increased.—A special meeting of stockholders of the Marconi Wireless Telegraph Company of America has been called for April 18 for the purpose of increasing the authorized capital stock from $1,662,000 to $10,000,000.

MARKET PRICES.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Allis-Chalmers	⅝	1⅞	Mackay Companies..	79½*	80
Allis-Chalmers, pf...	4	5¾	Mackay Cos., pf....	70*	69⅛
Amalgamated Cop...	80¾	82	Philadelphia Elec....	18	18¼
Boston Edison.....	299	295	Western Union.....	83⅞	83⅛
C'monwealth Edison.	146½	146	Westinghouse	78½	76
Elec. Storage Bty...	54½	54½	Westinghouse, pf....	121⅞	122½
General Electric.....	166¾	167½			

*Last priced quoted.

Personal

Mr. L. M. Webb, formerly of the Brilliant Electric Company, has taken a position with the department of publicity of the National Electric Lamp Association, Cleveland, Ohio.

Mr. T. H. Aldrich, of the National X-Ray Company, of Chicago, delivered an illustrated lecture on March 28 before the Nela Engineering Society, Cleveland, Ohio, on "Indirect Lighting."

Mr. Charles M. Howe, formerly assistant manager of the Chicago office of the Allis-Chalmers Company, has been made general sales manager of the George Cutter Company, of South Bend, Ind.

Mr. James Kent has resigned his position as manager of the Pittsburgh office of the Ft. Wayne Electric Works to become affiliated with the George T. Ladd Company, consulting engineer, as vice-president.

Mr. J. W. Reeve has resigned as manager of the Ware County Light & Power Company, Waycross, Ga., to accept the position of superintendent of the Ware County Light & Power Company, Madison, Fla.

Prof. Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, spoke on the subject of "New Methods of Photographing Sound Waves" at the luncheon of the Electrical League of Cleveland March 29.

Mr. George V. S. Williams, formerly counsel for the New York State Conservation Commission, has entered upon his duties as Public Service Commissioner for the First District of New York, succeeding Mr. William McCarroll.

Mr. W. A. Everson has resigned his position as general manager of the Hamilton (Ohio) Gas & Electric Company to become associated with the Domhoff & Joyce Company, Cincinnati. His successor will be Mr. Warren Howell.

Dr. Henry S. Carhart, who recently retired on a Carnegie grant as professor of physics at the University of Michigan, has been provided with a special research laboratory at the Throop Polytechnic Institute, Pasadena, Cal., where he will live hereafter.

Mr. W. M. Skiff, assistant manager of the engineering department of the National Electric Lamp Association, read a paper on "The Development of the Incandescent Lamp" before the Engineering Society of Notre Dame University at South Bend, Ind., March 25.

Mr. S. B. Cushing, statistician of the Public Service Company of Northern Illinois, addressed the Armour Institute branch of the A. I. E. E. in Chicago on March 27. He detailed in an interesting manner the progress of a technical graduate in a public-service corporation.

Mr. G. H. Stickney, chairman of the New York Section of the Illuminating Engineering Society, delivered an address on April 2 before a meeting of the American Cotton Manufacturers' Association at Washington, his subject being "Illuminating Engineering Co-operation."

Mr. H. H. Magdsick, of the engineering department of the National Electric Lamp Association, read a paper on "Gas, Gasoline, Electric Arc and Incandescent Electric Street Lighting" before the Engineering Society of the University of Wisconsin, at Madison, Wis., March 28.

Mr. Ernest G. Byng, vice-chairman of the General Electric Company, Ltd., and **Mr. G. Maurice,** manager of the fixture and heating departments of that company, are on a visit to this country, and hope to locate some new apparatus and appliances for introduction into Great Britain and its colonies.

Messrs. F. M. Bowman, secretary, **Wayne Rawley,** manager of structural works, and **A. Bovard,** engineer, of the Riter-Conley Manufacturing Company, of Pittsburgh, Pa., have resigned these positions and are organizing a large manufacturing concern in conjunction with the Blaw Steel Centering Company.

Mr. W. P. Poynton, formerly with the motive power department of the Interborough Rapid Transit Company and for the past two years rotary-converter engineer with the New York erecting department of the Westinghouse Electric & Manufacturing Company, has resigned to take the position of sales engineer for W. J. Jeandron, 172 Fulton Street, New York.

Mr. Charles Hewitt, who organized the Edison Company, Paterson, N. J., in 1887, and was subsequently connected with the Sprague Electric Railway & Motor Company, the Edison General Electric Company and the General Electric Company, has resigned as superintendent of motive power of the Philadelphia Rapid Transit Company, with which he has been connected since 1894.

Mr. R. F. Schuchardt, electrical engineer of the Commonwealth Edison Company, delivered an interesting illustrated lecture before a joint meeting of the Commonwealth Edison Girls' Club and the Commonwealth Edison Company Section of the National Electric Light Association in Chicago on March 26. His subject was "A Trip to the Panama Canal, the Canal Zone and Central America."

Prof. Alexander J. Wurtz, prominently identified with the early development of the lightning arrester and the Nernst lamp in America, has made a donation of $2,000 to Cornell University to be loaned to needy students in the two upper classes of the Sibley College of Engineering. Professor Wurtz is now professor of electrical engineering at the Carnegie Technical Schools, Pittsburgh, Pa.

Mr. Stephen A. Sewall, fuel expert for the Denver Gas & Electric Light Company, has been appointed assistant to Mr. T. C. Martin, secretary of the National Electric Light Association. Mr. Sewall is thirty-five years old and the son of Prof. J. A. Sewall, city chemist and first dean of the University of Denver. He was born in Denver and was connected with the Denver Gas & Electric Light Company for ten years.

Mr. J. W. Fraser has tendered his resignation as assistant chief engineer of the Southern Power Company, Charlotte, N. C., to assume charge of the erection for the British Westinghouse Electric & Manufacturing Company in Tasmania, Australasia, of a 70,000-kw hydroelectric plant to be operated by the Hydroelectric Power & Metallurgical Company. Mr. Fraser, who received engineering degrees from McGill University, Montreal, Can., in 1895 and 1899, was connected with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and the Shawinigan Water & Power Company prior to becoming associated with the Southern Power Company in 1906. Since that time his experience has covered the design and construction of transmission lines for emfs of from 2200 to 100,000 volts, more than 300 miles of the system of the Southern Power Company being operated at the latter voltage. Mr. Fraser will sail on April 15 for Manchester, England, from which place he will later proceed to Tasmania.

Mr. Ray Palmer, who was appointed city electrician of Chicago by Mayor Harrison on March 19, is the first technical graduate to hold the position and is also a man of practical experience. He was born in Sparta, Wis., in 1878, and is a graduate of the electrical engineering department of the University of Wisconsin, class of 1901. After leaving college Mr. Palmer was employed by J. G. White & Company on installation work for arc lighting near New York City. A few months later he was transferred to the London office of the same concern, where he served nearly three years as assistant electrical engineer. In 1904 he returned to this country and became electrical engineer for the old Chicago Union Traction Company, now merged in the Chicago Railways Company. Two years later Mr. Palmer resigned from this position, and since then he has been a consulting electrical engineer in Milwaukee and Chicago. He investigated the Milwaukee water-works system, reporting on the efficiency of the system and also on the question of electrolytic corrosion of buried water pipes. Quite recently Mr. Palmer has made a similar investigation of electrolysis in Chicago for the Department of Public Works of the city government.

RAY PALMER

Construction

TUCSON, ARIZ.—The Arizona Tel. & Teleg. Co. is planning to erect a new exchange plant at Pennington and Main Streets. C. W. Hinchcliffe is manager.

ROGERS, ARK.—The Rogers Lt. & Wtr. Co. is planning to extend and improve its electric system and to build a pumping station. W. S. Merkle, 1005 New Bank of Commerce Building, St. Louis, Mo., is consulting engineer.

CHINO, CAL.—The Southern California Edison Co. has awarded a contract to the F. O. Engstrom Co., Los Angeles, for the construction of a new substation at Chino.

COLTON, CAL.—W. W. Brison is interested in a project to build an interurban railway to connect cities in Riverside and San Bernardino Counties.

EXETER, CAL.—The Tulare County Pwr. Co. has been granted a franchise to erect transmission lines in Exeter.

FRESNO, CAL.—Through the purchase of five electric plants in the Salinas Valley the Huntington and Balch power interests have taken preliminary steps for the connection of the coast section with Fresno County and the San Joaquin Valley by means of transmission lines. The plants purchased are located at San Miguel, Paso Robles, San Luis Obispo, Arroyo Grande and Santa Maria. The price paid is said to be $1,000,000. Work will begin at once on the erection of a transmission line from Coalinga to the Stone Canyon, in the coast range mountains, and thence to the coast, to transmit electricity to the five plants. It is proposed to reconstruct the five systems, which will involve an expenditure of between $3,000,000 and $4,000,000.

LOS ANGELES, CAL.—Work will soon begin on the installation of the new ornamental street lamps on Seventh and other streets. R. H. Manahan, city electrician, will have charge of the work.

LOS ANGELES, CAL.—A trust deed for $1,000,000 has been filed by the El. Pwr. Co. in favor of the Security Trust & Savings Bank in the office of the county recorder. The proceeds will be used to construct a large power plant at the headwaters of the San Gabriel River and to build tunnels for the transmission of power to San Bernardino and Los Angeles County.

OCEANSIDE, CAL.—The establishment of a municipal electric plant is under consideration by the City Trustees. It is proposed to purchase the electric plant of the Oceanside El. & Gas Co., if satisfactory terms can be made; if not, the trustees are authorized to make preparations to submit a proposition to issue bonds for the installation of a municipal lighting system.

OROVILLE, CAL.—The Oro El. Pwr. Co. will soon begin work on the construction of a hydroelectric plant on Feather River, about 50 miles from Oroville.

PASADENA, CAL.—The Pacific El. Ry. Co. is planning to extend its Eagle Rock line to Glendale, at a cost of about $25,000.

RED BLUFF, CAL.—The Sierra Pwr. Co. has filed a trust deed with the county recorder for $3,000,000 in favor of the Oakland Bank of Savings. The money, it is stated, will be used for the construction of a power plant on Battle Creek, east of Manton, in Tehama County.

ROSEVILLE, CAL.—The Board of Trustees has decided to accept the offer of the Great Western Pwr. Co. to supply electricity here, under the terms of which the company agrees to duplicate the system of the Pacific Gas & El. Co. for $10,000 and to supply electricity at the rate of 1 cent per kw-hr. for a period of 10 years.

SACRAMENTO, CAL.—Negotiations have been consummated whereby the Great Western Pwr. Co. will take over the plant and holdings of the South Side Pwr. Co. The transmission lines of the South Side Pwr. Co. extend to Brighton on the east, the M Street road on the south and the Sacramento River on the west, giving the Great Western company the suburban district east, south and to the river on the west.

SAN JACINTO, CAL.—The Southern Sierras Pwr. Co. has completed its transmission line to the city limits on Seventh Street and will continue into the city as soon as a franchise can be secured from the City Trustees. The line will carry 10,000 volts to the local substation, where it will be stepped down for distribution.

SANTA BARBARA, CAL.—A special election has been called to submit the proposition to grant a 45-year franchise to George A. Batchelder and George I. Cochran, who have agreed to expend $250,000 immediately in reconstructing the local street railway system. They also promise to make extensions in the near future involving an expenditure of about $250,000. The Santa Barbara & Suburban R. R. Co., recently incorporated with a capital stock of $750,000, proposes to take over the property of the Santa Barbara Consol. R. R. Co., under the proposed new franchise.

TROPICO, CAL.—At an election held recently the proposition to issue $20,000 for a municipal electric-light plant was defeated.

NEW HAVEN, CONN.—The officials of the New York, New Haven & Hartford R. R. Co. have been considering the question of equipping a number of smaller branch lines in Connecticut for electrical operation.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Commissioners of the District of Columbia, Washington, D C., until April 10, for furnishing one 125-kw direct-current generator direct-connected to horizontal steam turbine. Specifications and form of proposal may be obtained on application to the purchasing officer.

GAINESVILLE, FLA.—Bids will be received by the city of Gainesville until April 29 for the sale of $125,000 in bonds, of which the proceeds of $50,000 will be used for building or acquiring a light plant, $40,000 for extension to water-works system and the remainder for paving.

AMERICUS, GA.—At an election held March 20 the proposition to issue $65,000 in bonds for the installation of a municipal plant was defeated.

CORNELIA, GA.—Preparations are being made by the Wofford Shoals Lt. & Pwr. Co. for the construction of a hydroelectric plant on Nancy Town Creek, near Cornelia. The work will include a concrete power station, 30 ft. x 40 ft., and a hollow reinforced-concrete dam 30 ft. high. The plant will cost about $40,000 and will develop about 500 hp. J. A. Wells is treasurer.

DALLAS, GA.—Gordon Simmons, of Atlanta, has leased the lighting plant of the Dallas Lt. & Pwr. Co. for a period of 12 years, and will make improvements to same. Mr. Simmons is endeavoring to secure control of the Paulding County El. Co., which owns a valuable water power just outside of the town.

FITZGERALD, GA.—Contracts have been placed for the installation of an ornamental street-lighting system in the business district. Forty lamp standards carrying five lamps each will be erected.

ABINGDON, ILL.—The Galesburg Ry. & Lt. Co. has applied to the City Council for a franchise to install an electric-light plant here.

CHICAGO, ILL.—The properties of the Illinois Tunnel Co. were purchased at public auction on March 26 by Louis C. Krauthoff and William S. Todd, who represented the purchasing committee of the reorganization committee appointed by the bond and stockholders of the Chicago Subway Co., the Chicago Warehouse & Terminal Co., the Illinois Tunnel Co. and the Illinois Tel. Construction Co.

ELGIN, ILL.—Plans are being considered for the installation of an ornamental lighting system in the district bounded by Grove Avenue, River Street, Spring Street and Division Street. About 150 five-lamp standards will be required.

MOUND CITY, ILL.—Negotiations are under way for the purchase of the properties of the Mound City El. Lt. & Pwr. Co. by the McKinley system. It is understood that about $35,000 will be expended for improvements in Mound City, which will be a substation. The Cairo plant will supply electricity for the local system and for Mounds. When improvements are completed a 24-hour service will be established.

URBANA, ILL.—The installation of an electric-light plant in the Illinois Theatre is said to be under consideration.

VILLA GROVE, ILL.—Plans are being prepared by the Villa Grove El. Co. for the construction of a new plant to replace the one recently destroyed by fire. The plans provide for a power house 68 ft. x 74 ft. An artificial ice plant will also be installed.

VIRDEN, ILL.—Sealed bids will be received until April 10 by Mayor O. A. Rothenbuecher for not less than 10 or more than 15 ornamental standards for electric lamps with appurtenances.

ALBANY, IND.—Arrangements have been completed by the Travelers' Protective Association, Post Q, for the installation of a "White Way" in the business district of this city. Julius Sapinsky, Charles M. Zink and J. A. Kraft have been appointed to take charge of the work.

EVANSVILLE, IND.—The merger of the Evansville & Southern Indiana Trac. Co. and the Evansville Public Service Co. has practically been completed. Work will be started immediately on the enlargement of the Public Service Co.'s plant at Fifth and Mulberry Streets. Additional boilers and converters to change the current from alternating to direct current for street-cars will be installed. When improvements are completed the power house of the traction company at Goodsell and Water Streets will be abandoned.

KENDALLVILLE, IND.—The proposition to purchase electricity from the Toledo & Chicago Interurban Ry. Co. has been rejected. Plans are being prepared for improvements to the municipal electric-light plant by F. H. Froelich, engineer, bids for which will be called for as soon as plans are completed. The cost of the work is estimated at $35,000.

WALTON, IND.—The citizens are considering the question of securing electric light and power service in Walton. It is proposed to grant a franchise to a private company.

ANITA, IA.—At an election held March 25 the proposition to grant an electric-light franchise to P. A. Johnson, of Atlantic, Ia., was carried. A company has been organized under the name of the Anita El. Lt. & Pwr. Co. to install and operate the plant.

EMMETSBURG, IA.—F. B. Persons has been granted a franchise to establish an electric-light and power plant here. The new plant will be erected in connection with the power plant of the Northwestern Tile & Clay Products Co., of which Mr. Persons is manager.

LAURENS, IA.—At an election held recently the proposition to construct a municipal electric-light and power plant was carried. G. W. Harper is town clerk.

MANLO, IA.—C. Buckley & Co. have been granted a franchise to construct and operate an electric-light plant here.

REMSEN, IA.—Preparations are being made by the Remsen El. Lt. & Pwr. Co. for the construction of an electric-light plant, bids for con-

struction of which will be opened April 8. The cost of the plant is estimated at about $8,000. H. H. Henningson, Omaha, Neb., is engineer.

ATCHISON, KAN.—The City Council, having made satisfactory arrangements with the Atchison Ry., Lt. & Pwr. Co., has abandoned the proposition to build a municipal electric-light plant. S. K. McCrary is city engineer.

PERRY, KAN.—Sealed proposals will be received at the office of the city clerk until April 10 for furnishing machinery and equipment for the installation of an electric-light system as follows: One 30-hp distillate engine with fuel tank and other necessary auxiliaries, one 15-kw dircet-current generator and switchboard, one storage battery with control panel, battery for 110-volt system, 160 amp-hr. capacity; one fuel storage tank, 10,000 gal. capacity; 29 60-watt multiple tungsten incandescent street lamps complete; pole line and distributing system for city. Plans and specifications and contract forms are on file at the office of the city clerk and at the office of George C. Shaad, Lawrence, Kan.

WELLSVILLE, KAN.—Plans are being considered for the installation of a municipal electric-light plant here. It is proposed to supply electricity for lighting the streets in the center of the town and business houses on Main Street and later to be extended throughout the town.

WILLIAMSBURG, KAN.—The installation of a municipal electric-light plant here is under consideration, to cost approximately $3,000.

BOWLING GREEN, KY.—The Kentucky Public Service Co., of Louisville, which recently took over several public-service corporations in Kentucky, including Bowling Green, is making improvements to the gas and electric plants here. An order has already been placed for a 1000-hp turbo-generator set for the electric plant and other machinery will soon be purchased.

LOUISVILLE, KY.—Plans and specifications have been completed by J. Earl Henry, architect and engineer of the Board of Education, for the installation of a lighting system in the auditorium of the Girls' High School.

LOUISVILLE, KY.—The Board of Public Works has adopted plans for lighting the city hall. Contracts for fixtures and wiring will soon be awarded. The entire building will be outlined with high candle-power lamps. Lamp standards will also be erected on the pavement surrounding the building.

LOCKPORT, LA.—The organization of a company to establish an electric-light plant, ice plant and water-works system is being promoted by A. V. Smith.

WINNFIELD, LA.—The Winnfield Ice & Cold Storage Co. is reported to have purchased the local electric-light plant and will install a generator and engine.

WATERVILLE, MAINE.—The Central Maine Pwr. Co. is extending its transmission lines to East Madison. The company will soon begin work on the erection of a trunk line between Showhegan and Waterville.

HAGERSTOWN, MD.—The Frederick & Hagerstown Pwr. Co. has petitioned the Public Service Commission for permission to issue $300,000 in capital stock and $300,000 in bonds to provide funds for the construction of a power plant. The company also asks for authority to enter into an agreement with the Hagerstown Ry. Co. and the Frederick Ry. Co. whereby all power developed at its power plants is to be furnished to the two railways for 12 years. The company proposes to build a power plant on Antietam Creek, at Security, at a cost of about $750,000. The power company was recently incorporated with a capital stock of $500,000 by Emory L. Coblentz, Henry Holzapfel, Jr., Victor M. Cushwa, Edwin W. Poe and Horatio L. Whitridge.

HAVERHILL, MASS.—C. A. B. Halvorson, electrical engineer, with the General Electric Co., Lynn, has been engaged to prepare plans for the illuminating system for the retail and shoe districts of the city, as proposed by the Haverhill Advertising Club and Haverhill Board of Trade. It is estimated that about 63 luminous arcs will be required.

LYNN, MASS.—Plans are being considered by the Board of Trade and the Merchants' Association for the installation of an ornamental street-lighting system in the business district. The merchants have subscribed $12,000 for the purchase of lamp standards and lamps and the Lynn Gas & Electric Co. is ready to expend $20,000 to install the lamps. The City Council has been asked to provide $4,900 per year to pay for the current to maintain the system.

SOUTH FRAMINGHAM, MASS.—At an election held March 19 the proposition to establish a municipal electric-light plant was defeated and the Selectmen were authorized to enter into a 10-year contract with the Edison El. Illg. Co. of Boston for municipal lighting.

WAKEFIELD, MASS.—At a town meeting held recently $15,000 was appropriated for improvement to the municipal lighting plant.

ANN ARBOR, MICH.—Sealed proposals will be received at the office of Gardner S. Williams, consulting engineer, Ann Arbor, until April 22 for the construction of a reinforced-concrete and brick power house, reinforced-concrete arch spillway, earth embankment and tailrace excavation for the Barton plant of the Eastern Michigan Edison Co. near Ann Arbor. Approximate quantities of the principal items will be as follows: 12,000 cu. yd. earth excavation, 50,000 cu. yd. earth embankment, 4500 cu. yd. concrete and 70 tons reinforcing steel. Plans and specifications are on file at the above office. Copies may be obtained on application to Gardner S. Williams, consulting engineer, for which a deposit of $25 will be required, of which $20 will be refunded upon return of plans.

TRAVERSE CITY, MICH.—At an election held March 28 the proposition to issue $150,000 in bonds for the purchase of the property of the Queen City El. Lt. & Pwr. Co. was carried.

ALBERT LEA, MINN.—A petition has been presented to the City Council asking that steps be taken to establish a municipal electric-light plant here.

DULUTH, MINN.—The City Council voted unanimously not to make a contract with the Duluth Edison El. Lt. Co. and offered to purchase the plant of the company. The city recently voted for municipal ownership of lighting plant.

FOLEY, MINN.—The Village Council has granted a franchise to Harmon Becker to construct and operate an electric-light plant here.

ROSEAU, MINN.—A franchise has been awarded to S. F. Banaime and others to construct and maintain an electric-light plant here.

WARREN, MINN.—The Council is not contemplating the establishment of a municipal electric-light plant, as reported in the issue of March 30. The city has a municipal plant. W. Haney is superintendent.

WORTHINGTON, MINN.—The Council contemplates the installation of an additional generating unit in the municipal electric-light plant and other improvements necessary to establish a 24-hour service.

ZUMBROTA, MINN.—Investigations have been made by representatives of the Cannon Falls Elec. Ser. Co. in Zumbrota with a view of supplying electricity here for lamps and power for both of the clay plants. The company, it is stated, proposes to purchase the local plant, owned by C. D. Denison, if satisfactory arrangements can be made.

ELLISVILLE, MISS.—At an election held recently the proposition to sell the municipal electric-light plant to the Laurel Lt. & Ry. Co., Laurel, for $6,000 was carried. If the offer is accepted, the electric railway from Laurel to this city will be completed within 18 months.

TYLERTOWN, MISS.—J. C. Flippen and C. H. Stevens have been granted a franchise to construct and operate an electric-light system here.

AURORA, MO.—The Lawrence County Wtr., Lt. & Cold Storage Co. has completed the erection of its transmission line to Marionville and contemplates the erection of additional lines during the coming summer. W. S. Merkle, 1005 New Bank of Commerce Building, St. Louis, Mo., is consulting engineer.

BUTLER, MO.—The city is contemplating the installation of additional generating machinery in the municipal electric plant.

JENNINGS, MO.—David P. Leahy, of St. Louis, Mo., contemplates the installation of an electric-light service in Jennings, plans and specifications for which have been prepared by W. S. Merkle, New Bank of Commerce Building, St. Louis. Jennings has not a post office.

LEWISTON, MONT.—The Lewiston Pwr. Co. is planning to erect a power plant on Spring Creek to supply this city with electricity for lamps and motors.

NORFOLK, NEB.—President H. W. Winter of the City Council has signed the contract with the Sugar City Cereal Mills, under which the company is to furnish electricity for pumping the city water for a period of five years at the rate of 2¼ cents per kw-hr. The company will begin the service as soon as a transformer and other equipment have been installed in the mills and an automatic pump at the city pumping station.

SEWARD, NEB.—The Blue River Pwr. Co. has secured a site along the river on which it proposes to erect a second power plant.

SHELTON, NEB.—The Shelton Lt. & Pwr. Co. is planning to improve its system during the coming summer.

NEWPORT, N. H.—The citizens have voted to appoint a committee to look into the matter of extension of the electric-light system in the town, also improvements to the present service, and to make a contract for municipal lighting for the ensuing year on any basis it may deem equitable for the town, provided the amount of the contract does not exceed $2,000.

HACKETTSTOWN, N. J.—The Hackettstown El. Lt. Co. contemplates extending its transmission line to Vienna and Great Meadows to supply electricity for lamps in those villages.

HOBOKEN, N. J.—Plans are under way for the installation of ornamental street lamps on Washington Street, from Newark to Fourth Street. Herman Geisman is interested.

DEMING, N. M.—The Federal Lt. & Trac. Co. has purchased the properties of the Deming Ice & El. Co. here and proposes to install additional equipment in the plant and extend the transmission system to several new points in the Mimbres Valley. Electricity furnished by the plant will be used chiefly for operating irrigation pumping plants.

LORDSBURG, N. M.—D. A. Layne and W. D. Murray, of Silver City, are planning to install an electric-light plant and ice factory. Transmission lines will be erected from the plant to the Shakespere mining district. Robert E. Cameron is manager.

MORA, N. M.—Preparations are being made by the El. Installation Co. of New Mexico for the installation of a 7½-kw hydroelectric plant in Mora, bids for which have been received. The cost of the proposed plant is estimated at from $2,500 to $5,000. Henry M. Shaw, Las Vegas, is manager.

ANTWERP, N. Y.—The Village Board has entered into a contract with the Antwerp Lt. & Pwr. Co. for street lighting for a period of five years. The contract calls for tungsten lamps. The company was also awarded a contract for pumping the village water, at $1,000 per year.

BUFFALO, N. Y.—The Public Service Commission has directed the Buffalo & Lake Erie Trac. Co. to install an additional feeder line, extending from its substation at Athol Springs to the Blackwell Canal, on the Hamburg Pike, the cables to be connected to the feeder system between the Ridge Road and Hamburg.

CAMDEN, N. Y.—The City Council is considering an ordinance providing for a $300,000 bond issue for the construction of a municipal electric-light plant.

ELMIRA, N. Y.—The Eclipse Machine Co., at Elmira Heights, is planning to equip its plant for electrical operation throughout, contract for which has been awarded to the Turner El. Co., Elmira.

GLEN PARK, N. Y.—At an election held recently the proposition for lighting the village by electricity was approved.

JAMESTOWN, N. Y.—Arrangements have been made by the Empire Case Goods Co. for building an addition to its plant on Foote Avenue. The plans provide for a new power plant and equipping the factory for electrical operations.

CHARLOTTE, N. C.—Sealed proposals will be received by the Board of Water Commissioners until April 11 for setting electrical apparatus and wiring and furnishing and installing steam and water piping in the Catawba River pumping station of the Charlotte water works, plans and specifications for which are on file in the office of Gilbert C. White, engineer, Charlotte.

WHITAKERS, N. C.—Bids will be received by the Mayor and Commissioners at the office of the Mayor until April 17 for construction of an electric-light plant. For further information address J. O. Hearn, Whitakers. C. E. Fairbanks, 417 American National Bank Building, Richmond, Va., is engineer.

BINFORD, N. D.—The Commercial Club is considering the question of securing an electric-light plant for Binford.

PORTLAND, N. D.—Arrangements are being made to secure electric-light service in Portland from Mayville, 2 miles distant.

COLUMBUS, OHIO.—The Finance committee of the City Council has recommended that two ordinances be drawn, one appropriating $17,290 for completing the cluster-lighting system in the business section and the other $57,710 for the erection of substations and 500 arc lamps.

LIMA, OHIO.—The installation of an ornamental street-lighting system on Main Street, from Wayne Street to the Pennsylvania Railroad, is under consideration by the property owners. It has not yet been decided whether to use street arches, incandescent lamps or arc lamps.

NAPOLEON, OHIO.—Plans have been adopted for improving the illumination of the business section of the city. Tungsten cluster lamps will be used.

SHILOH, OHIO.—L. T. Cooper, a member of the Cooper Medicine Co., contemplates the installation of an electric-light plant to supply electricity here. It is proposed to install electrical equipment in the old mill on the Stillwater River, located on his farm.

WOOSTER, OHIO.—Proposals will be received by Charles E. Thorne, director of the Ohio Agriculture Experiment Station, until April 25 for the construction of an addition to its power house as per plans and specifications on file at the Experiment Station.

YOUNGSTOWN, OHIO.—The Merchants' Association has submitted a proposition to the City Council offering to erect and equip 168 ornamental lamp standards in the business district. The offer provides that the standards shall be turned over to the city free of cost if it will agree to maintain them after Jan. 1, 1913.

YOUNGSTOWN, OHIO.—The City Council has authorized the public service director to expend $175 for the purpose of engaging an electrical engineer to make investigations and report to the Council as to the feasibility and cost of installing an electric-light plant at the market house to furnish electricity for the proposed ornamental street-lighting system in the business district.

HOLDENVILLE, OKLA.—Sealed proposals will be received by Willard S. Levan, city clerk, Holdenville, until April 13 for material and machinery for extensions and improvements to the water-works system as follows: For 15,000 lin. ft. of 10-in. cast-iron pipe; 20,000 lb. of lead; one electric generating unit, consisting of one 75-kva, 2300-volt, three-phase, 60-cycle generator direct connected to horizontal steam engine, switchboard and instruments complete; 45,000 ft. No. 6 waterproof copper iron; 130 northern cedar poles, 30 ft. long, 6-in. tops, with cross-arms, guys, braces, insulators, etc.; one bronze fitted horizontal turbine pump, having a capacity of 625 gal. per minute against a head of 112 ft. direct connected to a 35-hp, 2300-volt, three-phase, 60-cycle motor, with auto starter; one 72-in. x 18-ft. horizontal-return tubular boiler. Specifications are on file at the office of the city clerk or may be obtained from Goodwin & Harper, 920 Scarritt Building, Kansas City, Mo., consulting engineers.

IDABEL, OKLA.—The Idabel Lt. & Fuel Co. has applied for a 20-year franchise in Idabel.

OKLAHOMA CITY, OKLA.—Sealed bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 1, for the installation of a vacuum-cleaning system in the United States post office at Oklahoma City, in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the superintendent, Oklahoma City. James Knox Taylor is supervising architect.

BECHTELSVILLE, PA.—The installation of an electric-light plant in Bechtelsville is under consideration.

CAMP HILL, PA.—The Borough Council has adopted a resolution authorizing the secretary to make investigations to ascertain the cost of installing a municipal electric-light plant and water-works system.

COATESVILLE, PA.—The installation of a municipal electric-light plant is under consideration by the Borough Council.

INTERCOURSE, PA.—The Intercourse El. Lt., Ht. & Pwr. Co. has increased its capital stock from $6,000 to $15,000.

PHILADELPHIA, PA.—Bids will be received at the office of the U. S. Marine Corps, Depot of Supplies, 1100 South Broad Street, Philadelphia, Pa., until April 11, for installing one electric generating unit. For further information address Cyrus S. Radford, assistant quartermaster, in charge of depot.

SHARON, PA.—The stockholders of the Mahoning & Shenango Valley Ry. & Lt. Co. have authorized an increase in the capital stock of the company from $10,000,000 to $65,000,000, the proceeds to be used for extensions as needed.

WEST BROWNSVILLE, PA.—The Lily Coal & Coke Co. is planning to install equipment at its new plant at West Brownsville, Pa., at a cost of about $300,000. The plant will be equipped for electrical operation and will have an output of 3000 tons daily. S. A. Scott, McDonald, Pa., and Thomas Lily, Brownsville, are among the directors.

PROVIDENCE, R. I.—The Narragansett El. Ltg. Co. has petitioned the State Legislature for permission to increase its capital stock from $7,000,000 to $10,000,000. The company contemplates extensive improvements which if carried through will involve an expenditure of $800,000. Arthur B. Lisle is general manager.

PROVIDENCE, R. I.—The special committee on lighting franchise of the City Council has submitted a proposition to the Narragansett El. Ltg. Co. involving a 10-year exclusive franchise for lighting the streets and a five-year exclusive power franchise. If the proposition is accepted by the company and ratified by the City Council, it will save the city about $100,000 per year. The cost of the system proposed is estimated at about $256,940. The plans provide for 450 arc lamps at $85 each per year, 550 arc lamps at $75 per lamp per year, four triple arc lamps at $235 each, 50 five-lamp tungsten clusters at $90 each per year, 5000 tungsten lamps at $14 each per year and 200 tungsten lamps at $19 per lamp per year.

WOONSOCKET, R. I.—A bill has been presented to the State Legislature providing for an increase in the capital stock of the Woonsocket Electric Machine & Pwr. Co. from $500,000 to $700,000.

GARRETSON, S. D.—The proposition submitted by Emil Benson for the installation of an electric-light plant here has been approved and a franchise will be granted the company by the City Council. Under the terms of the agreement the company will furnish 15 100-watt lamps and five 150-watt lamps, at $62.50 per month.

CROCKETT, TEX.—The capital stock of the Crockett Ice, El. Lt. & Pwr. Co. has been increased from $10,000 to $20,000. It is proposed to make improvements to the plant.

LIVINGSTON, TEX.—Arrangements have been made whereby the Livingston Mfg. Co. will light the streets of the town with electricity.

MARLIN, TEX.—The City Council has granted a franchise for the installation of an electric light and power system here to Waco (Tex.) capitalists.

NACOGDOCHES, TEX.—At an election held March 19 the proposition to issue $65,000 in bonds for an electric-light plant, a sewerage system and street paving was carried.

PORT ARANSAS, TEX.—Jones & Cotter are contemplating the installation of an electric-light plant in Port Aransas.

PORT LAVACA, TEX.—The Port Lavaca Lt. & Pwr. Co. is contemplating extending its lighting system to outlying districts of the towns and will also furnish an all-night service.

BARTON, VT.—The Village Trustees have been instructed to install an additional water wheel and dynamo at the municipal electric-light plant at Charleston. The cost is estimated at from $8,000 to $9,000.

RICHMOND, VA.—Sealed proposals will be received at the office of the supervising architect, Department of the Treasury, Washington, D. C., until May 13 for furnishing two electric passenger elevators, two hydraulic lifts and pumping plant in the reconstruction of the U. S. post office, court house and custom house at Richmond, Va., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

EDMONDS, WASH.—Arrangements are being made for the construction of an electric railway from Eighty-fifth Street in Seattle through Edmonds to Everett. C. T. Beeson is president of the company and W. C. Bickford chief engineer.

KELSO, WASH.—The Washington-Oregon Pwr. Co. contemplates extending its transmission line from Kelso to Centralia and Chehalis.

PUGET SOUND, WASH.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 27 for furnishing two 100-kw motor-generator sets and controlling panels at the navy yard, Puget Sound, Wash. Specifications may be obtained on application to the bureau or to the commandant of the navy yard named. The cost of the work is estimated at about $8,000. William M. Smith is acting chief of bureau.

SEATTLE, WASH.—W. J. Haycock and associates have been granted a 20-year franchise to build and operate a hydroelectric plant.

BLOOMINGTON, WIS.—The Lancaster El. Lt. Co., Lancaster, has applied to the Village Board for a franchise to supply electricity for lamps, heat and motors here.

COUDERAY, WIS.—Surveys are being made by the Arpin Lumber Co., of Grand Rapids, Wis., for the construction of a large dam on the Chippewa River, in Radisson, work on which will begin in the near future.

MINERAL POINT, WIS.—The Mineral Point El. Lt. Co. has been reorganized under the name of the Mineral Point Pub. Service Co. The company is contemplating extending its transmission lines this year to Mifflin, Rewey, Clifton, Edmund, Cobb, Shea, Highland and Wingville. The new line is to be built to carry 13,200-volt, three-phase current. Vaugh & Meyer, of Milwaukee, are consulting engineers. F. C. Ludden is president.

MERRITT, B. C., CAN.—The Merritt Pwr. & Lt. Co. is reported to have submitted a proposition to sell its plant to the town.

BRANTFORD, ONT., CAN.—The Hydro-Electric Power Commission has submitted estimates of the cost of installing apparatus for distributing 1000 hp in this vicinity. The overhead system, using wooden poles, is estimated to cost $98,849, and an underground distributing system with installation of ornamental lamp standards, carrying five-lamp clusters, $178,602.

DUNDAS, ONT., CAN.—The Dominion Pwr. & Transmission Co., it is reported, contemplates the erection of a new substation and will remodel the electric plant here. W. C. Hawkins, Hamilton, is general manager.

LONDON, ONT., CAN.—The London & Lake Erie Transportation Co. has entered into a contract with the Hydro-Electric Commission for 500 hp or more at $28 per hp. The company proposes to make improvements to its system, including the purchase of new cars and other equipment, to cost about $10,000.

PETERBORO, ONT., CAN.—Application has been made to the Ontario Legislature by the City Council for permission to expropriate the plant of the Peterboro Lt. & Pwr. Co.

MOOSE JAW, SASK., CAN.—Sealed tenders will be received by the City Commissioners until April 17 for a steam plant under contract "D" as follows: Section 1—water-tube boilers and accessories; Section 2—mechanical draft equipment; Section 3—fuel economizer; Section 4—coal and ash-handling equipment. Specifications and all information may be obtained on application to J. D Peters, electrical superintendent.

New Industrial Companies

THE BAIRD EQUIPMENT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 by Robert C. Wheeler, Cecil Barnes and Charles L. Cobb. The company proposes to manufacture electrical and mechanical goods.

THE BUFFALO ELECTRIC VEHICLE COMPANY, of Buffalo, N. Y., has been incorporated by William J P. Seipp, William C. Feuchter and Thomas R. Wheeler, all of Buffalo. The company is capitalized at $1,000,000 and proposes to manufacture and deal in motor vehicles, etc.

THE ELECTRICAL ENGINEERING & CONTRACTING COMPANY, of Raleigh, N. C., has been incorporated with a capital stock of $15,000 by S. T. Stewart, C. N. Freeman and B. E. Taylor. The company proposes to construct electric and gas lighting systems and install steam-heating plants, etc.

THE ENGSTROM ELECTRICAL MANUFACTURING COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $10,000 for the purpose of manufacturing electrical and mechanical goods. The incorporators are: Nels A. Engstrom, George A. Mayer and Ivan Engstrom.

THE GAS & ELECTRIC DEMONSTRATOR COMPANY, of Stamford, Conn., has been granted a charter with a capital stock of $350,000 for the purposes of manufacturing electrical appliances. The incorporators are: Barton L. Babcock, A. E. Peat and H. M. Smith, of New York.

New Incorporations

BIRMINGHAM, ALA.—The Tidewater Pwr. Co. has filed application for a charter with a nominal capital stock of $2,000 for the purpose of supplying electricity for lamps and motors in Birmingham, Bessemer, Brookwood, Tuscaloosa, Gadsden, Attalla, Alabama City, Ashville, Springville and other towns and cities. The officers of the company are: J. M. Dewberry, president, and R. D. Johnston, Jr., secretary. The main office of the company will be located in Birmingham.

PINE BLUFF, ARK.—The Pine Bluff Co. has been incorporated by Henry B. Stillman, Walter Haviland, Henry M. Haviland, Charles A. Lewis, Arthur N. Taylor, William B. White and Smith Weygant. The company is capitalized at $1,200,000 and proposes to operate street railway, electric light and power systems in the city of Pine Bluff and other places.

LOS ANGELES, CAL.—The Southern California Utilities Co. has been incorporated by W. S. Peloubet, Maurice Salzman and Myron M. Willice. The company is capitalized at $10,000,000 and proposes to erect a power plant to supply electricity to the San Diego, Riverside & Los Angeles Ry. Co.

RIVERSIDE, CAL.—The Riverside-Redlands Ry. Co. has been chartered with a capital stock of $2,500,000 for the purpose of building an electric railway to connect Riverside, Redlands and intervening towns. Charles E. Johnson and others are interested.

RIVERSIDE, CAL.—The Southern California Utilities Co. has been incorporated with a capital stock of $10,000,000 for the purpose of generating and distributing electricity in San Diego, Riverside and Ocean Counties. The incorporators are: Charles E. Waite, M. M. Milice, La Monte Simms, of Riverside; W. S. Peloubet and Maurice Salzman, of Los Angeles.

SAN BERNARDINO, CAL.—The Ontario & Upland Tel. Co. has been granted a charter with a capital stock of $300,000 by R. B. Campbell, W. A. Freemire, J. R. Pollock, R. G. White and others.

Trade Publications

STORAGE BATTERIES.—In its Bulletin No. 135 the Electric Storage Battery Company, Philadelphia, describes the installation of "Chloride" batteries used for signaling and interlocking at the new Chicago passenger terminal of the Chicago & Northwestern Railway. Use is made of a total of 533 cells for this purpose.

RAILWAY MOTOR.—Descriptive Leaflet No. 2440 of the Westinghouse Electric & Manufacturing Company describes the Westinghouse split-frame commutating-pole railway motor 323-A. This motor has a rating of 32 hp at 500 volts and 38 hp at 600 volts. The leaflet describes and illustrates in detail the component parts of the motor, and in addition shows the performance curves at both the rated voltages.

STEAM TURBINES.—"Terry Service" is the title of an attractive booklet brought out by the Terry Steam Turbine Company, 90 West Street, New York. It shows the wide range of uses of the company's turbines now in use driving generators, pumps, forced-draft and gas blowers, etc. It also gives the names of prominent installations and is striking evidence of the increasing use of small steam turbines in various industries.

Business Notes

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, has added to its sales force Mr. A. E. Lubeck, who will travel in the Central States with headquarters in Chicago. It has also secured the services of Mr. Otis L. Johnson, formerly with the National Lamp Association, who will have charge of the illuminating department.

GEORGE CUTTER COMPANY.—As the result of the recent combination of the George Cutter Company, of South Bend, Ind., and the J. Lang Electric Company, of Chicago, arrangements are under way to conduct the major part of the manufacturing operations of the George Cutter Company, which is the name of the combined company, at South Bend. Ultimately, however, it is believed that the executive and sales departments will be managed from Chicago.

THE ZEE SOCKET & MANUFACTURING COMPANY has been recently incorporated to manufacture incandescent-lamp sockets under the Schoenberg and Both patents. The principal members of this corporation are: B. B. Dinsmore and Frederick Duggan, of the Imperial Porcelain Works, Trenton, N. J.; John H. Parker, of C. S. Knowles, Boston, and Ralph A. Schoenberg, of the Sarco Company. The Zee Socket & Manufacturing Company will operate plants at New Bedford, Chelsea and Burrage, Mass.

RICKARD & SLOAN.—Messrs. William L. Rickard and Clifford A. Sloan announce the organization of an advertising company, which will conduct its business under the corporate name of Rickard & Sloan. The offices of the company are located in the Evening Post Building, 20 Vesey Street, New York. Particular attention will be given to the planning and management of advertising campaigns for concerns engaged in the manufacture of mechanical and electrical apparatus and accessories. The service of the company will include the writing and placing of advertising in trade and other periodicals and the production and distribution of bulletins, catalogues and circulars.

MADSEN RESEARCH LABORATORY.—Mr. Charles P. Madsen, electric heating engineer, who has had his office and research laboratory at 38 North Clinton Street, Chicago, since last summer, recently met with a fire loss which did not cause serious damage to his laboratory and equipment, but rendered the building unsuitable to use and compelled Mr. Madsen to seek new quarters. In order to take care of a great increase in business which he has enjoyed the last few months, he is separating his office and drafting department from the laboratory. His office is now located at 324 McCormick Building, and the laboratory has been removed to Lewis Institute, where Mr. Madsen has carried on considerable research in the past and has delivered a number of lectures. Mr. Madsen will have at Lewis Institute a private laboratory of his own supplemented by the other facilities there.

Directory of Electrical Associations, Societies, Etc.

Alabama Light & Traction Association. Secretary-Treasurer, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York. Convention, Chicago, Ill., Oct. 7-11, 1912.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Convention, Boston, Mass., April 18-20, 1912.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Convention, Richmond, Va., Sept. 3-5, 1912.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson. Engineering Societies Building, 29 West 39th St., New York. Meeting, second Friday of each month, excepting June, July, August and September. Annual meeting, Boston, Mass., June 25-28.

American Physical Society. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.

Arkansas Association of Public Utility Operators. Secretary, E. H. Hardin, Hot Springs, Ark. Convention, Little Rock, Ark., May 20-22.

Association of Edison Illuminating Companies. Secretary, H. T. Edgar, Seattle, Wash.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, Ohio.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago.

Colorado Electric Club. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Colo.

Colorado Electric Light, Power & Railway Association. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Colo.

Electric Club, Chicago. Secretary, W. M. Connelly, 1417 Monadnock Block, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trade Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Vehicle Association of America. Assistant Secretary, Harvey Robinson, 245 West 42d St., New York. Meeting, fourth Tuesday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla.

Gas, Electric & Railway Association of Oklahoma. Secretary, H. V. Bozell, Norman, Okla.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, A. Newburger, 1153 Myrtle Ave., Brooklyn, N. Y.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Next meeting at Berlin in 1913.

Iowa Electrical Association. Secretary, A. W. Zahm, Mason City, Ia. Convention, Des Moines, Ia., April 24-25, 1912.

Iowa Street & Interurban Association. Secretary, H. E. Weeks, Davenport, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Annual meeting at Manhattan, Kan., Oct. 17-19, 1912.

Louisiana Electrical Association. Secretary, W. H. Bower Spangenberg, 627 Poydras St., New Orleans, La. Meets third Monday of each month.

Maine Electrical Association. Secretary, Walter S. Hyman, Waterville, Maine.

Minnesota Electrical Association. Secretary, E. F. Strong, Chaska, Minn.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham, Springfield Gas & Electric Co., Springfield, Mo. Convention, Joplin, Mo., April 11-13, 1912.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next annual convention at Detroit, Mich., June 25-27, 1912.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next annual convention, July 17-19, 1912, Denver, Col.

National Electric Light Association. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Next annual convention at Seattle, Wash., June 10-13, 1912.

National Electric Light Association, Canadian Section. Secretary, T. S. Young, 220 King St. West, Toronto, Can. Convention, Ottawa, Ont., June 19-21, 1912.

National Electric Light Association, Commercial Section. Secretary, P. S. Dodd, 1823 E. 45th St., Cleveland, Ohio.

National Electric Light Association, Eastern New York Section. Secretary, W. A. Wadsworth, Schenectady Illuminating Company, Schenectady, N. Y.

National Electric Light Association, Georgia Section. Secretary-Treasurer, T. W. Peters, Columbus Railway Company, Columbus, Ga.

National Electric Light Association, Michigan Section. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich. Convention, June 21-25, S.S. *Majestic.*

National Electric Light Association, Mississippi Section. Secretary, A. H. Jones, McComb City, Miss. Convention, Vicksburg, Miss., May 28-30.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, New England Section. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

National Electric Light Association, New Hampshire Section.

National Electric Light Association, Northwest Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, W. E. Long, Philadelphia, Pa.

National Electric Light Association, Power Transmission Section. Secretary, D. B. Rushmore, 234 Union St., Schenectady, N. Y.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1343 Marquette Bldg., Chicago.

National Electrical Inspectors' Association. Secretary, W. L. Smith, Concord, Mass.

National Electrical Supply Jobbers' Association. Secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

National Fire Protection Association. Secretary, R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

National Independent Telephone Association. Secretary, Richard Valentine, Janesville, Wis.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New Orleans Electrical Contractors' Association. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next annual meeting, Breakers Hotel, Cedar Point, Ohio, July 16-19, 1912.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. I. E. Sanborn, Ohio State University, Columbus, Ohio.

Pittsburgh Electric Booster Club. Recording Wattmeter, O. R. Bombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

Rejuvenated Sons of Jove. Jupiter, R. L. Jaynes, Pittsburgh, Pa.; Mercury (Secretary), E. C. Bennett, St. Louis, Mo.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. B. Moore, 39 Trinity Place, Boston, Mass. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

Southwestern Electrical & Gas Association. Secretary, D. G. Fisher, 3419 Hall St., Dallas, Tex. Convention, San Antonio, Tex., April 25-27, 1912.

Street Railway Association of the State of New York. Secretary, J. C. Collins, Rochester, N. Y.

Vermont Electrical Association. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill. Convention St. Louis, Mo., Jan. 27-30, 1913.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, Tuesday after Jan. 1 each year.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis.

Wisconsin Electrical Contractors' Association. Secretary, Albert Petermann, Milwaukee, Wis. Summer meeting, Waupaca and Chain-of-Lakes, Wis., August, 1912.

Wisconsin Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 26, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,020,975. SELECTIVE SIGNALING SYSTEM; E. R. Gill, Yonkers, N. Y. App. filed Dec. 8, 1909. Telephonic train dispatching.

1,020,976. APPARATUS FOR METERING CONVERSATIONS IN AUTOMATIC TELEPHONE EXCHANGES; G. Grabe, Nikolassee, Germany. App. filed July 28, 1910. Acts after termination of the conversation.

1,020,991. PROCESS OF ELECTRIC WELDING; L. S. Lachman, New York, N. Y. App. filed May 8, 1907. A separate welding piece is used to form a spot weld.

1,021,016. QUICK-BREAKING ELECTRIC-SWITCH MECHANISM; T. W. Thomas, Cleveland, Ohio. App. filed Feb. 4, 1910. Car-controller switch.

1,021,045. SECONDARY ELECTRIC CLOCK; E. A. Hummel, St. Paul, Minn. App. filed July 31, 1907. For synchronized train clocks.

1,021,054. EXPULSION-FUSE CIRCUIT-BREAKER; W. J. Lietzenmayer, Webster, N. Y. App. filed April 15, 1907. The blowing of the fuse operates a switch arm in series.

1,021,059. INSULATOR; W. R. Markley, Findlay, Ohio. App. filed Jan. 4, 1911. Two-part clamping porcelain.

1,021,077. TROLLEY HARP; O. W. Smith, Springfield, Ohio. App. filed June 23, 1910. Detachable from the pole.

1,021,080. COMBINED CIGAR-TIP CUTTER AND LIGHTER; D. A. Thomas, Denver, Col. App. filed March 21, 1910. Improvement on Patent No. 711,171.

1,021,097. ELECTRICALLY HEATED TOOL; J. S. Hansen, Brockton, Mass. App. filed Nov. 19, 1910. A treeing iron.

1,021,100. COMBINATION MAIL-BOX AND SIGNALING MECHANISM; S. S. Hopkins, Waynesboro, Va. App. filed April 1, 1910. Rural free-delivery box.

1,021,101. SEPARABLE ATTACHMENT PLUG; H. Hubbell, Bridgeport, Conn. App. filed May 11, 1911. Has an interior insulating guard disk.

1,021,106. THREE-WIRE MERCURY METER; R. C. Lanphier, Springfield, Ill. App. filed March 22, 1911. The armature spindles are directly connected without gearing.

1,021,132. SPACE TELEGRAPHY; S. Cabot, Brookline, Mass. App. filed Nov. 18, 1905. Method of transmitting and receiving.

1,021,177. SWITCH SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 10, 1909. Pull-chain type for incandescent lamps.

1,021,179. TAPPING ATTACHMENT; R. S. Blake, Chicago, Ill. App. filed June 2, 1910. Lamp-plug socket.

1,021,187. ELECTRIC FURNACE; A. E. Greene, Pueblo, Col. App. filed April 1, 1908. Continuous ore reduction.

1,021,195. SOCKET FOR ELECTRIC LAMPS; G. C. Kanuff, Chicago, Ill. App. filed Oct. 16, 1911. Miniature socket for automobile lamps.

1,021,206. TROLLEY POLES FOR ELECTRIC TRACTION SYSTEMS; E. M. Munro, London, England. App. filed April 29, 1911. Two interconnected poles for overhead conductors.

1,021,208. ROTARY SNAP-SWITCH; C. D. Platt, Bridgeport, Conn. App. filed Oct. 27, 1911. Indicator type. (See Clark patent, No. 906,386).

1,021,221. TRANSFORMER; M. O. Troy, Schenectady, N. Y. App. filed April 28, 1908. For constant alternating-current circuit with a movable coil.

1,021,227. AUTOMATIC MOTOR-STARTING RHEOSTAT; P. Zimmer, Schenectady, N. Y. App. filed Feb. 10, 1905. Series resistance gradually cut out.

1,021,230. ELECTRIC HEATER; H. P. Ball, Pittsfield, Mass. App. filed Feb. 16, 1910. The heater plate is grooved and the conductor held in place by bending parts of the metal.

1,021,234. PROCESS OF MANUFACTURING PURE NITRIC OXID; R. M. von Berneck, M. Moest and H. Graf, Höchst-on-the-Main, Germany. App. filed May 10, 1911. Electrolysis of nitric and nitrous acid.

1,021,239. ELECTRIC TOASTER; A. S. Cubitt, Pittsfield, Mass. App. filed Nov. 17, 1909. Pivoted toasting frames.

1,021,243. CAP-LINING FASTENER FOR ELECTRICAL LAMP SOCKETS; E. H. Freeman, Trenton, N. J. App. filed Sept. 8, 1911. Spring locking ring with catch projections.

1,021,250. CONTROL SYSTEM FOR PROJECTORS AND THE LIKE; J. L. Hall, Schenectady, N. Y. App. filed April 7, 1910. Remote control system.

1,021,252. BELL-RINGING TRANSFORMER; S. E. Johannesen, Pittsfield, Mass. App. filed Aug. 14, 1909. Simple core and coil construction.

1,021,256. RESISTANCE; R. Miller, Jr., Schenectady, N. Y. App. filed Jan. 7, 1910. Shunt for a measuring instrument.

1,021,259. IMPULSE TRANSMITTER; E. Neuhold, Friedenau, Germany. App. filed April 22, 1910. Subscriber's station for automatic telephone systems.

1,021,266. TURBO-GENERATOR; R. H. Rice, Lynn, Mass. App. filed Sept. 22, 1909. For train lighting.

1,021,289. SINGLE-PHASE MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Sept. 2, 1909. Commutator type.

1,021,293. INSTRUMENT SET FOR ELECTRICAL DISTRIBUTION SYSTEMS; V. G. Apple, Dayton, Ohio. App. filed May 17, 1907. Electric ignition for gas engines.

1,021,333. REGULATOR; F. E. Ricketts, Baltimore, Md. App. filed May 26, 1909. Automatic field-circuit regulator for generators.

1,021,339. INDICATING PUSH-BUTTON; W. R. Schlage, San Francisco, Cal. App. filed Aug. 1, 1911. To indicate "in" or "out."

1,201,340. MEANS FOR ATTACHING BINDING POSTS TO DRY BATTERIES; W. A. Scott, Tacoma, Wash. App. filed Oct. 14, 1911. Split posts.

1,021,373. WATERPROOF SWITCH BOX; R. R. Miller, Pueblo, Col. App. filed May 16, 1910. Automatic railroad switch.

1,021,377. ELECTRICAL CONNECTOR; J. C. Royce, Toronto, Ont., Can. App. filed May 20, 1910. Expansible split pin and tube.

1,021,383. PRESSURE REGULATOR; M. V. Smith, Hartford, Conn. App. filed Feb. 18, 1911. For pneumatic steam and electric systems such as a brake system.

1,021,420. SHOE FOR THIRD-RAIL ELECTRIC CARS; L. A. McCoubrie and C. F. Raydure, Philadelphia, Pa. App. filed Dec. 21, 1911. Under-running improvements on Patents Nos. 985,430 and 1,009,767.

1,021,434. PORTABLE FACE MASK FOR TELEPHONE USE; L. C. Stockton, Denver, Col. App. filed July 10, 1909. A shell for receiving the face for talking.

1,021,453. TERMINAL STRUCTURE; C. W. Davis, Edgeworth, Pa. App. filed July 1, 1909. The conductors pass out between the flanges of an insulator.

1,021,478. ELECTRIC INDUCTION FURNACE; J. H. Reid, Newark, N. J. App. filed March 19, 1910. The heating coil may be let down into any one of a number of hearths.

1,021,494. TELEPHONE SYSTEM; S. L. Van Akin, Jr., Liverpool, N. Y. App. filed Feb. 2, 1910. A receiver and transmitter mounted together.

1,021,540. ELECTRIC SWITCH; E. T. Lockard, Cincinnati, Ohio. App. filed Aug. 4, 1909. For motor-driven adding machines, etc.

1,021,549. FUSE CASE; T. E. Murray, New York, N. Y. App. filed April 18, 1911. Reticulated metal cartridge.

1,021,550. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Sept. 18, 1911. A fuse may be locked in place.

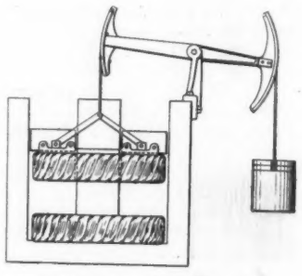
1,021,604. CIRCUIT-BREAKER; H. E. Howe, Windber, Pa. App. filed Dec. 4, 1911. For trolley wires. (Improvement on Patents Nos. 949,537 and 950,922.)

1,021,637. MEANS FOR REMOVING ICE FROM TROLLEY WIRES; J. A. Sloan, Westville, Ill. App. filed Jan. 6, 1911. Motor-driven cutter.

1,021,704. ELECTRIC DRIER; T. B. Ray and W. Laford, New York, N. Y. App. filed June 24, 1911. For drying beer vats.

1,021,717. COMBINED TELEPHONIC AND TELEGRAPHIC SYSTEM; E. R. Gill, Yonkers, N. Y. App. filed Aug. 3, 1907. For railway-train dispatching, etc.

1,021,732. ELECTRIC WELDING MACHINE; A. C. Taylor, Warren, Ohio. App. filed July 20, 1911. For spot-welding, etc.; lever or treadle operating.



1,021,221.—Transformer.

1,021,734. PROCESS FOR PROTECTING SHIPS FROM BARNACLES; G. Delius and C. P. Tatro, Seattle, Wash. App. filed May 22. 1911. Reversible current.

1,021,746. OIL SWITCH; C. C. Badeau, Boston, Mass. App. filed Feb. 20, 1909. Removable oil well.

1,021,752. SAFETY APPLIANCES FOR TRAMWAY CARS; J. E. Schoolfield, San Francisco, Cal. App. filed Feb. 9, 1911. The weight of a person on the step prevents the car from moving.